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MEMORY

AN INDUCTIVE STUDY

Frederick Melton

BY

F. W. COLEGROVE, PH.D., D.D.

Professor of Philosophy in the University of Washington

WITH AN INTRODUCTION

BY

G. STANLEY HALL, LL.D.

"And slight withal may be the things which bring
Back on the heart the weight which it would fling
Aside forever!
It may be a sound—
A tone of music—summer's eve—or spring—
A flower—the wind—the ocean which shall wound,
Striking the electric chain wherewith we are darkly bound."
—*Childe Harold.*

SECOND EDITION, REVISED

NEW YORK

HENRY HOLT AND COMPANY

1901

94237
23/12/08

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ROBERT DRUMMOND, PRINTER, NEW YORK.

PREFACE

An effort has been made to study the memory or memories by the inductive method. More than one-third of the work is new material, and the aim has been to restate the remainder in accordance with the latest scientific facts, yet in language so simple as to be easily understood. As to the success of the effort the reader will judge. Although more than one-half of the manuscript was rewritten after a visit to several German universities, most of the facts were collected and put in much their present form at Clark University. To President G. Stanley Hall, one of the most scholarly and suggestive of classroom lecturers, the writer is chiefly indebted. Professor W. H. Burnham and other members of the philosophical faculty gave valuable judgments and criticisms. Mr. Louis N. Wilson, the librarian, rendered efficient aid. The writer desires, furthermore, to acknowledge his indebtedness to Dr. Adolph C. Meyer of the Worcester State Hospital for frequent assistance. He is also deeply indebted to the superintendents and physicians in the State Hospitals

of New York, Middletown, Conn., and the Hartford Retreat; also to the many professors and instructors in colleges, normal schools, academies, and high schools who have sent returns to the questionnaire edited in Chapter VI. If space permitted, it would be pleasant to mention a long list of names. The large amount of assistance, unselfishly given by many individuals, constitutes a most pleasing recollection of a task for the present, at least, reluctantly brought to a close.

SEATTLE, WASHINGTON,
January, 1900.

INTRODUCTION

BY G. STANLEY HALL, PH.D., LL.D.

THE author of the following treatise has had a rich and varied experience as academic principal, professor, and, later, president of Ottawa University, and has been an experienced and successful academic teacher of philosophical subjects. As Honorary Fellow in Psychology at Clark University, he has devoted two years to a careful and comprehensive study of the most recent literature upon the many phases of memory, and herewith presents to psychologists and teachers a general survey of his subject, such as has been long desired but long delayed.

The points of view represented by the different chapters are so varied that they have required an unusually large range of methods. The history of previous and current theories on memory had to be carefully gone over and concisely epitomized; the biological orientation gives breadth of view; the recent and striking advances in the study of the minute anatomy of the brain, so far as this is thought to be asso-

ciated with psychic processes, had to be surveyed; the author has also made original studies and observations among the insane where memory defects are a striking feature; he has interviewed a large number of aged people, and has also employed the questionnaire method in Chapter VI in perhaps as thorough and comprehensive a way as it has yet been used here, and his results based upon statistical studies and tabulations of which the text gives no intimation are contributions of real value to contemporary psychology. He has given some attention not only to mnemonic methods, but also to the questions of practical pedagogy, recitations, and examinations so far as connected with memory training, so that practical teachers will find this a serviceable *vade mecum.*

Despite the many special laboratory, clinical, and other studies of memory and countless theoretical exploitations of the subject, a plain, simple, scientific handbook was still lacking, so that from the practical point of view, as well as from the service always rendered by juxtaposing and comparing different aspects of great subjects, such a book as this is very opportune.

It is easy, as some have done, to interpret all mental activities and phenomena from the standpoint of memory, loss of which means mental vacuity. As all psychic activities are conditioned by retentiveness of some kind; as this conservating faculty not only fills the conscious but also

dominates the unconscious soul and rules even the nervous system; as all the past in the life of the race and individual is committed to its keeping, aided by mnemonic devices as well as history, the problem of specially cultivating it in the wisest and most effective way includes a large part of the whole problem of education. From the larger point of view all the motor activities from creeping and walking, up, all intellectual acquisitions and emotional endowments and attributes, to say nothing of reason, will, and imagination, the formation and exercise of common sense, of taste and critical judgment, are all of them in a sense and at root special features of the memory problem. Apart from the conclusions drawn by the author, these pages are suggestive; they will stimulate other conclusions in the mind of every serious reader, and, as I hope and believe, will tend toward a larger and more generic view of the subject by specialists and the better conformity to the true laws and phenomena of memory on the part of teachers.

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MEMORY

CHAPTER I

HISTORICAL ORIENTATION

Hail, Memory, hail! In thy exhaustless mine
From age to age unnumbered treasures shine!
Thought and her shadowy brood thy call obey,
And Place and Time are subject to thy sway!
ROGERS: *Pleasures of Memory.*

THE following historical résumé aims to orientate the reader by a concise statement of the views held by representative writers of different periods concerning memory.

To no other people perhaps has the world seemed so fresh and new as it appeared to the ancient Greeks; although influenced to a certain extent by oriental culture, they were little hampered by traditions, customs, or history, and were able to bring to bear upon literature and philosophy, in an original way, the powers of a comparatively ripe intellect. The world seemed new, and at first intuition naturally played the chief mental rôle; but as the results of observation and reflection seemed fit to be preserved, the memory was developed. This was

all the more necessary, as there were no written records. Moreover, when the Greeks realized their religious yearning in the gods and goddesses with which they peopled the heavens and the poems of Homer were sung into existence, they found a stronger incentive for transmitting their literature by the aid of memory. The people felt called to tell the coming generations of the deeds of Achilles, Agamemnon, and Menelaus. For a long time the poems were learned and recited *memoriter*. The art of the rhapsodist arose, and Memory became the mother of the muses.

As in the individual, memory at first takes the precedence of the higher intellectual processes for which it is a preparation, so the intellectual life of Greece unfolded. But the higher processes of philosophic speculation and thought gradually came into the foreground. The culture at Delphi prepared the way for the deepest questions which the Ionic school and its successors tried to answer. The question of the origin of things and the search for a first principle were emphasized, and the early philosophers paid little or no attention to the memory. This theme formed a very minor part of the teachings of the sophists, yet a good memory must have been essential to conduct their legal quibbles and to develop the rich language which Socrates and Plato found ready to use. Plato (428–347 B.C.) first clearly emphasized

the importance of the memory, and expressed the belief that it would be injured by the invention of writing.[1]

The first attempt to explain the nature of memory is given in his writings[2] as follows: Every man has presumably in his mind a block of wax of various qualities which is the gift of Memory—the mother of the muses. Upon this block the perceptions which he wishes to remember are sealed or stamped. The memory continues only so long as the impression remains. He assumes that memory stands related to the archetypal ideas which the mind conceives as through reminiscence one recalls the ideas which he learned in a previous state of existence. This teaching was utilized[3] by Cicero to explain the rapidity with which a child accumulates knowledge, and finds its counterpart in the philosophy of Schelling who represents the individual Ego as retaining faint mementoes of the path upon which it arose, but forgetting the path itself. Schelling makes it the duty of philosophy to reconstruct the forgotten past in order that the Ego may be enabled to recall its history and to retrace the course along which it came to the point whence it was separated from the universal and became self-conscious. This would be a reminiscence of what it had done and suffered in its universal state. Is

[1] Phædrus. [2] Theætetus. [3] De Senectute.

there an analogy between this effort to associate the individual memory with the universal and that of Hering and Haeckel to regard the universal unconscious instinct as a memory? Of course the latter view does not find its source here, but there may be a similar process of thought in the two periods widely separated. Cicero (106–43 B.C.) later discusses reminiscence under the figure of the wax and seal. Plato refers to the principles of similarity, contrast, and simultaneity as means employed in recollection.[4] Like Plato, Aristotle (385–322) gave the memory a setting which harmonized with his own psychological views, and, as we might expect, was more practical. With rare power of psychical analysis he stated three laws of association which are widely held in some form to-day,—contiguity in time and place, resemblance, and contrariety. Meditation cherishes a fact and aids retention. While he does not conduct a psychophysical discussion in the modern sense, he refers the memory images to the heart where they are supposed to be recorded; these images (species or perceptible forms) are remembered and not the objects themselves. He treated the subject from a comparative point of view, and taught that animals have the power of memory, but as the process involves time, only those

[4] See Zeller's "Plato and the Older Academy," p. 127, fine print; also "Memory," by Professor W. H. Burnham, *American Journal of Psychology*, vol. ii.

animals which have a sense of time can remember. He makes a clear-cut distinction between memory and reminiscence as well as between memory and the imagination; memory is localized in the past, while imagination belongs to the future also. The memory is not always to be trusted, as even the intellectual memory has its phantasms.[5]

The skeptics concern themselves chiefly with the reason and naturally pay little attention to the memory. We find the subject clearly though briefly treated by the Stoics and Epicureans. The teaching of the former resembles Plato's; that of the latter reminds us of Aristotle. The Stoics[6] considered the soul at birth to be a blank page upon which sensation writes, or it is a wax tablet upon which an impression is made. "Perception gives rise to memory, and repeated acts of memory to experience." In other words, memory retains and utilizes previous knowledge which forms the basis of personal experience. The idea of personality does not yet seem to be sharply defined. The Epicureans[7] thought that through sense perception the mind forms a general picture of

[5] "Memoria et Reminiscentia," vol. iii., Opera Omnia; Aristotle's "Psychology," by Wallace, p. 94; Porter's "Human Intellect," p. 191 ff.

[6] Zeno, founder, 350-258 B.C.

[7] Epicurus, founder, 341-270 B.C. See Zeller's "Stoics, Epicureans, and Skeptics."

what it perceives. Such pictures are retained in memory and form the basis of notions or ideas which are also remembered.

The Neo-Platonists gave a passing attention to the subject, but the next serious attempt at a philosophical explanation was made by St. Augustine (354–430 A.D.), who attaches much importance to memory. As the basis of all intelligence and will, it forms with them a mental trinity; yet the fact of remembrance depends upon the will. The subject naturally became involved in theological discussion: men and angels remember, but God, who is above motion and change, does not remember. He distinguishes also between the sense memory and the intellectual memory; the former retains impressions and mental images of objects, while the latter retains the things themselves.[8]

It is interesting to know that the ancients considered mnemonic aids and developed the nucleus of the modern mnemonic systems. Cicero would retain the order of the words and sentences by associating them with objects. He would use places, wax tablets, and symbols as mnemonic helps, and considered the local memory as important.[9] Quintilian (35–95 A.D.) re-

"Memory," by Professor W. H. Burnham, *American Journal of Psychology*, vol. ii., p. 56 ff. For his Platonic views see Neander, vol. ii. See also Sir William Hamilton's "Metaphysics," pp. 412, 413.

[9] "De Oratore."

lates how Simonides, having left the guests at a banquet, returned to find the walls fallen and their bodies crushed beyond recognition. He recognized the bodies because he remembered the order in which the guests reclined. He uses the banquet incident as the basis for a mnemonic system. He would localize in a house the objects to be remembered under the form of symbols, i.e., he would represent a ship by an anchor; he would place some objects in the vestibule, and others in the various rooms. Public buildings, city walls, or a long road were utilized for localization. This method of localization has ever since formed a chief feature of mnemonic systems.[10] Quintilian taught that the memory which forms the basis of knowledge is a treasury of eloquence and extremely serviceable to the extemporaneous speaker. He believes that it can be improved by exercise. He ascribes the remarkable ability of animals to return to their homes to memory.

Regarding the ancient philosophy as a whole we find a painstaking effort on the part of the foremost writers to give a psychological explanation of memory. If their analysis was incorrect, the defect was due to a faulty psychology. They assigned to the memory an important place among other mental processes. The laws of the association of ideas were developed so

[10] "Institutes," bk. ii., chap. ii.

fully that they have met with slight change up to the present time. These writers developed and utilized a mnemonic system as a more or less essential part of education. Finally, we are impressed by the almost complete absence of recognition of the physical basis of memory. This limitation was inevitable, as they were ignorant of the structure and functions of the nervous system.

We now pass over a long and barren period in the realm of thought from St. Augustine to the Middle Ages. During this time the memory played a large rôle, perhaps the chief one, in education; but no great thinker appeared to add to the sum of knowledge bequeathed by the ancient world, and for a long time the teachings of the latter were unknown and not utilized. Even John Locke,[11] in his epoch-making essay concerning human understanding, adds scarcely a new idea regarding the subject. If his views were not drawn directly from the authors already cited, they are almost restatements of the same. His oft-quoted sentence, "The pictures drawn in our minds are laid in fading colours," finds its counterpart in St. Augustine's statement that forgetfulness is a continuous process. In harmony with his psychology, he taught that there is nothing conserved

[11] "An Essay concerning Human Understanding," vol. i., chap. x.

in the memory which is not derived from the senses. He seems to have observed independently that birds are endowed with the power to remember, as is seen from their efforts " to conform their voices to notes of which they have no ideas."

In the eighteenth century we begin to find an obscure yet distinct tendency to consider both the physiological and psychical elements in memory study. Yet only a beginning is made in the line of research which must await another century for its large development. The slight movement, although only a premonition, is significant. In an exceedingly crude manner Descartes (1696–1750) recognizes the physiological function. He teaches that traces of objects are left upon the brain, which impressions indirectly serve the animal spirits in recollection. This view assumes importance only as indicating a tendency to recognize the mediation of the brain in memory. This idea was elaborated in a striking manner by Malebranche (1638–1715) and Bonnet (1720–1793). Malebranche emphasizes the close relation between habit and memory,—a relation which receives its chief accent in the psychological literature of to-day. Bonnet developed this thought and derived all ideas from the senses. Memory is psychical in nature, but finds a physical correlative in the vibration of the nerve-fibres or in sensation. The sense-organs and nerves vary in structure, giving to

each perception a character which distinguishes it from every other one. The theory of a physical basis of memory is discussed in a bold manner by Condillac (1638–1715), who imagines a statue or automaton receiving impressions from a single sense, as of smell. These impressions accumulate and form the basis of the intellectual life. Thus the intellect grows from external sense impressions, the most important of which is touch. As the statue retains the sense impression, it is endowed with memory. We may regard it as doubtful, however, whether it could recall the fact that it had been a marble statue. The views of these four writers are crude, and for nearly a century all discussions regarding memory, like the psychology of which they form a part, bear a purely psychical tone. But this work is important as a step towards the physiologico-psychological treatment of the subject, and enables us to designate these authors as the precursors of the organic school.

We have now to consider the views of their contemporaries and successors during this century interval. For convenience these schools may be designated as the Scottish, the English Associational, and the Herbartian. Of the Scottish school the speculations of Hume gave rise to the masterly analysis of the mind by Kant, while Reid, Stewart, and Hamilton are wholly metaphysical and give a painstaking analysis of the "Faculties." David Hume (1711–1796),

like Locke, derives all ideas from sensation. Having distinguished two classes of perception in thoughts and impressions ("lively perceptions") he states that thoughts recall one another under the principles of resemblance, contiguity, and causality. Cause and effect, he writes, are conjoined, but not necessarily connected. We only infer their connection from experience. Hume emphasized the law of association and placed it upon a fundamental basis in psychology. Thomas Reid (1710–1796) did not accept in an unqualified form Hume's argument that memory gives a series of continued impressions from which we infer past identity; yet he emphasizes memory as a chief factor in personal identity, as it implies a belief in past duration and past objects. In opposition to Hume's skepticism he taught that memory is an original ability given by man's Maker, and that the Supreme Being possesses a greater degree of memory than man.[12]

Dugald Stewart (1753–1828) added that memory is not a distinct intellectual faculty, but a portion of a complex state. "Voluntary recollection is the coexistence of some vague and indistinct desire with our simple trains of suggestion."[13]

Sir William Hamilton (1778–1856) treated the

[12] "Collected Writings," vol. i., p. 339, edition of 1846.

[13] "Elements of Philosophy of the Human Mind," vol. i.

subject in a large way. In harmony with his general psychological analysis, he distinguishes between retention, representation, and reproduction, of which the last is the most important. Retention is memory proper. While memory depends largely upon physical conditions, a physiological explanation is unnecessary; although he rejects and refutes the physical theory concerning memory, his arguments are clothed with words closely resembling the language employed by the organic school of to-day. Regarding forgetfulness he writes: "The problem is not how mental activity endures, but how it ever vanishes." As a concrete illustration of the tenacity of memory he relates that Hippias boasted of having repeated five hundred words upon hearing them once. Seneca, referring to this statement and dwelling upon the loss of mental vigour in old age, stated that he himself had been able to repeat two thousand names after they had once been read to him. Muretus dictated words, Latin, Greek, barbarous, significant and insignificant, disjoined and connected, to a Corsican. The reading had tired all present, except the latter, who remained fresh and vigorous. Then, said Muretus, "Vidi facinus mirificissimum." He absolutely repeated all of the words in the same order in which they had been dictated.[14]

[14] "Metaphysics," pp. 411-436.

The Scottish school as a whole gave a more complete philosophy of mind than had hitherto existed, and in so doing arrived at a clearer analysis of the nature and function of memory. They appreciated and better defined the relation of memory to personality. While Hume, as already stated, firmly grounded the laws of association, it was the distinctive contribution of the English associational school to develop the doctrine of association and to place a strong emphasis upon this essential function of memory. Of this school, David Hartley[15] (1705–1757), the real founder, distinctly sets forth a theory of brain condition. He posits vibrations in the white cerebral matter, which are sustained partly by the ether in that organ and partly by the active, uniform, and continuous powers of the white substance. These vibrations revive in a feeble manner and awaken corresponding images which are associated in the soul. The doctrine of association thus enunciated was developed and emphasized by James Mill, Alexander Bain, and Herbert Spencer. With Mill "Remembering is association." In order to fix an idea we seek to fix a relation between it and some sensation or another idea which we know will come at the time desired. The idea of the thing and the idea of my having seen it make up the whole of the state of con-

[15] Ueberweg, vol. ii., p. 387.

sciousness which we term memory. Thus memory is really a series of images which terminate in the present feeling. The present self which remembers is to be distinguished from the remembered self.[16] Bain placed a very strong emphasis upon the elements of feeling and sensation in association. As a muscular feeling is retained after the physical cause ceases, so mental impressions depend upon the renewal of the feeling which accompanies the same part and in the same manner as the original feeling. So ideas of movement come to be associated with sensations, and help to reproduce each other. Muscular delicacy is of great importance in acquisition, as are both bodily strength and an active temperament.[17] Spencer's development of the doctrine of association consists of a close analysis of the intellect and feeling which harmonizes with his general psychology. He considers mind as composed of feelings and relations. There are relations between the feelings and between the relations. The physiological conditions for the revival of both are the same, viz., a complete state of repair in the nervous system, active circulation, and rich blood. (1) "Peripherally initiated feelings of external origin," such as sight, sound, taste, and smell, are more easily reproduced than (2) pe-

[16] "Analysis of the Phenomena of the Human Mind," vol. i. and vol. ii., p. 241 ff.

[17] "Senses and Intellect," 3d edition, 1868.

ripherally initiated feelings of internal origin, such as hunger and thirst; but both are more easily revived than (3) "centrally initiated feelings" or emotions.

In class (1) visual and auditory feelings are more easily revived than those of taste and smell. It is extremely difficult to revive and represent feelings of hunger and thirst. Emotions are less easily revived because there is not the same sharp distinction between actual and ideal emotion as between actual and ideal feeling of other kinds. The revivability of feelings and of relations varies with (1) the extent of their being relational; (2) with the vividness of the present feeling; (3) with their strength; (4) with repetition. Instinct is organic memory. Memory in its higher form arises from imperfectly organized and irregular internal relations. To remember a motion just made with the arm is to have a feeble repetition of those internal states which accompanied the motion. This feeble repetition is nascent memory. The organism remembers its own movements and sense impressions.[18]

In discussing the memory from the standpoint of one central idea, the English school more fully defined the relations between memory and personality, treating the subject on lines laid down

[18] "Synthetic Philosophy," vol. i., part 2, chaps. i.-viii.; part vi., chaps. v. and vi.

by Hume. By emphasizing the feelings and sensations, they recognized a wider range of soul elements than had their predecessors.

The unique school of psychology founded by Herbart (1776–1841) and ably explained by Dörpfeld and Steinthal has exerted a wide pedagogical influence. As will appear from the following analysis, Herbart's teaching concerning memory forms an important part of his psychological discussion. He posits as ultimate elements in the soul's life *Realien* or reals, which are independent of time and space. The soul, itself a simple real element, affords a battle-ground for the reals which struggle for existence. The stronger reals prevail, but the weaker ones are not destroyed; the latter fall below the threshold of consciousness, where they are not without influence, and await a more favourable opportunity to renew the struggle. Through the persistence of the reals, sensations, consciousness, and ideas are evolved. Like the reals from which they arise, the ideas engage in an incessant conflict. By working over the ideas the opposition between them is lessened and clearness gained. When stronger ideas overcome weaker ones and the latter fall below the threshold of consciousness, forgetting occurs. In the contest similar ideas fuse and assist one another. Disparate presentations are united by complication. Opposing ideas tend to inhibit one another. The perception of a thing shares

its consciousness with an earlier perception now latent and thus reproduces the latter. "A series of presentations is reproduced in consciousness in the same order in which it was originally perceived for this reason: each successive member of a series blends with all the other members of the series that are above the threshold of consciousness, with an energy proportional to the vividness of the latter."[19] With Dörpfeld memory includes all sensations, perceptions, representations, feelings, and will. Those ideas which cannot be reproduced or recalled, so long as they are not recalled, have no meaning for our mental life. If one of two contrary ideas which were previously united again becomes conscious, it helps revive the other. Thought depends upon a fusion of similar ideas. He reduces the laws of association to simultaneity.[20]

Steinthal designates the unconscious ideas as vibrating ideas, and states that the soul imparts life to them. The soul can be cognizant of only one completely abstract idea at a time. Fusion of ideas prepares the way for abstraction, and

[19] "Memory," Professor W. H. Burnham, *American Journal of Psychology*, vol. ii., p. 248.

[20] "Psychologie als Wissenschaft" ("Lehrbuch zur Psychologie"). G. F. Stout, *Mind*, 51, 52. Fauth, "Das Gedächtniss." Dr. H. J. Lukens, "Connection between Thought and Memory, based upon 'Denken und Gedächtniss,' by Dörpfeld."

the strength of the association is determined by the number of fusions. He extends the idea of apperception so as to include the simplest elements and sensations. The school of Herbart recognizes the mediation of the soul in all psychical processes, and in its hypothesis of the struggle, warfare, fusion, and interference of the reals is full of unique suggestions regarding the nature of the memory. Whether the psychology at basis be correct or not, the doctrine has kept alive the importance of memory as a factor in education.

It will now be seen that the teachings regarding memory have developed hand in hand with the growth of psychology as a whole. The nature, office, and importance of memory were unfolded and emphasized by the Scottish school; Hume and the English associational school placed accent upon and developed the doctrine of association, and probed more deeply than had hitherto been done into the relation of memory to personality; while Herbart and his followers developed a mental science on lines which at each step in the struggle form a basis for the memory.

It remains to trace the development of the organic school which has placed emphasis upon the physiological elements, and to consider the teaching of the modern physiological psychology for which this school was a preparation. We have noticed that Descartes, Malebranche,

Bonnet, Condillac, and Hartley emphasized the physical basis of memory and were the forerunners of the organic school. It remained, however, for Horwicz and his successors to give a more adequate recognition of the function of the nervous system. In his "Psychologische Analysen," published in 1872, Horwicz advances an empirical theory of the relation of mind to brain, and thus explains memory by the methods of modern physiological psychology. He assumes no common memory organ, but each particular sense organ and every part of the nervous system has its own memory. He is not a materialist, but psychical life has memories which are conditioned by the nervous organism. While feelings cannot easily be recalled, memory in its last analysis depends upon feeling. Ideas of the external world depend upon motor sensations which are based upon feelings. Living motion, then, associated with and dependent upon feeling, is revived, and with it the original presentation. Horwicz assumes particular nerve-cells which retain sense impressions. These are not confined to the brain, for the spinal cord has its own memory in reflex acts. The function of these cells is memory, just as other cells have a sensory function. Reproduction chiefly takes place in the large cerebral commissures. The fibres of the spinal cord are essential to association, and the commissures illustrate the reproductive process in the higher

centres. (1) The lateral commissure unites sensory and motor cells and is the path of reflex movement. (2) The anterior commissure unites motor cells and, diffusing excitations throughout the motor centres, mediates motor association. A disposition is thus formed in the motor paths. (3) The posterior commissure unites sensory cells and combines them into sensory complexes. The simplest form of reproduction is association by the transference of a state of excitation from one fibre to another in the central organ. He sums up his discussion in the following rather ponderous definition: "Reproduction is a transmission of stimuli preponderating toward the sensory side in definite directions determined by dispositions, and by residua remaining from previous states of excitation." Fechner had shown that sensations cannot be modified, while remembrance changes at pleasure. This difference, says Horwicz, is due to the will, which determines the persistence of memory. He distinguishes between remembrance and memory. The former recalls the place and time of the object perceived, while memory revives the idea content. Conscious memories adumbrate into unconscious ones. The latter stand at the threshold of consciousness, waiting to be summoned by the former. Each class exerts an influence upon the other. Simple inertia is not adequate to explain the persistence of ideas. The latter is due to

an abiding impulse, a persistent *Lebensakt.* Living, moving impulses are revived, and with them the corresponding percepts. The development of the brain depends upon the development of the mind. He unifies the soul by assuming that all memories are united into a prevailing one by the inhibitive power of the higher central organs. Other sensory tracts can be used only as their sensations stand related to the prevailing idea. Horwicz's theory of association may not hold in its entirety, but it bears an analogy to the recent theory of Flechsig. His work marks a distinct advance in the literature of memory, and prepares the way for his successors, Wundt and the more radical organic school.[21]

Professor Wundt also makes memory a psycho-physical process and definitely determines the function of each factor. His teaching is clearer and more scientific than that of Horwicz, and must be regarded as one of the best explanations of memory. Physiologically, all presentations leave in the central organism traces which are a functional disposition. Each idea is accompanied by a sense excitation. Each excitation of a central sense surface leaves a disposition to renew the excitation. These functional dispositions in the cerebral substance de-

[21] "Psychologische Analysen," vol. i. Fauth, "Das Gedächtniss." Professor W. H. Burnham in *American Journal of Psychology,* vol. ii., p. 254 ff.

termine what ideas shall be revived in consciousness, but are incapable of reviving them. Whether any percepts once experienced are revived depends solely upon the modification of consciousness. If any percepts are revived, the functional dispositions determine which ones and assign their limits, or they form favourable conditions for the psychical elements to act. Wundt has essentially modified the laws of association. He hesitates to accept those designated as similarity, contrast, and contiguity (inner and outer association) upon the ground that all of our ideas are complex, and because the renewal in an unchanged form of an earlier presentation never occurs. He forms two general classes of association, simultaneous and successive. Simultaneous associations comprise assimilation and complication. Assimilation is association between elements of like compounds. Complication is the union of elements of unlike compounds. Successive associations, also, are explained by assimilation and complication. In them the process of combining ideas is prolonged and may be divided into reproducing and reproduced elements. All memories and associations may be reduced to union by identity and contiguity. Recognition is essentially a memory process; for, in order to recognize a presentation, it must be identified with one previously acquired.[22]

[22] "Grundzüge der physiologischen Psychologie," vol. ii., p. 300 ff.

While Wundt takes cognizance of both the physical and psychical elements, a long array of authors who constitute the organic school of memory place accent upon the physical processes. We shall now consider this school, the reaction against its teachings, and the elective writers who adopted certain features of the views of each.

Hering takes a large view of memory. When he read his essay upon Memory as a Common Function of Organized Matter, he made an exceedingly important contribution to the subject. To be sure, like Haeckel, he arrives at this conclusion through deductive reasoning, but his theory has enlarged the study and stimulated research. As a basis, he accepts the doctrine of traces and functional disposition of matter which Wundt afterwards developed. He assumes, furthermore, that the phenomena of consciousness are functionally dependent upon, yet not caused by, the brain. He holds that the sympathetic nervous system, as well as the central, has its memory, and that memory is a common function of all living matter. He emphasizes the continuity of memory at every stage of life. When through exercise muscles grow, not only do the cells and fibres increase in size, but they multiply in number. A cell grown to a certain size divides into filial cells, each of which inherits the qualities of the parent. The cell itself (as is seen in plants) is reproduced. It may be in-

ferred that acquired as well as congenital characteristics are inherited. When the filial cell inherits the qualities of the parent cell, it may be said to remember what occurred in the parent organism. It repeats what it feebly experienced as a part of the greater whole, as an old man repeats the experience of childhood. Thus memory is a continuous process, and the whole series of organic life is the reproductive faculty of what belonged to the first organic form; for when the germ divided it bequeathed to its descendants its properties; thus individual development in the higher animals is merely reminiscence. His conception explains the so-called instincts. The innate reproductive faculty of the chick enables it to repeat very easily the performance of the mother. The ability of the spider to spin its web was acquired by innumerable generations of spiders, and constitutes an organic memory. The unconscious memory of nature is indestructible. He who leaves an impress upon it will be remembered forever.[23]

Ribot recognizes the modification of the nerve elements and emphasizes the dynamic associations between them. That nerve elements furnish the entire phenomena of retention and reproduction is evident in the secondary automatic activities (walking, writing, etc.), which

[23] "Ueber das Gedächtniss, als eine allgemeine Function der organischen Materie." See also publication on Memory, etc., by the Open Court Pub. Co.

are in themselves memories. Consciousness and the consequent ability to reproduce in time alone are wanting to make them complete memories. In every complete memory there are three elements: (1) retention; (2) reproduction; (3) localization in time. Organic memory possesses the first two; the third is superadded and unnecessary. Ribot emphasizes the fact that we have not memory, but memories. The physiological conditions of memory are: (1) a particular change in the nerve elements; (2) stable associations between different groups or complexes of nerve elements. Some neural discharges correspond to unconscious cerebration; some to vital activities; while only a few of them answer to consciousness. These dynamic associations are more important to conscious than to unconscious memories. The power of memories is directly proportional to their dynamic and static bases. His views upon localization in time may be briefly stated as follows: Most objects upon entering consciousness become parts of a time series which terminates in the present. Thus they become serviceable in recalling other objects. In the words of Taine, the image glides to and fro in past time, and each attempt to recall it gives it a new oscillation. As soon as it is correctly localized it is recalled. Stated otherwise, each image is localized between the present and some reference point in the series which is to be recalled. If the parts between the ref-

erence points did not fall away, there could be no recollection, or it would be an extremely long process. Forgetting becomes a condition of remembering. Ribot enunciated the following law of decay of memory, which he terms the Law of Regression. As is shown by a study of progressive amnesia, the intellectual faculties are extinguished before the affective. Higher complexes disappear before the lower. Associations best organized disappear last. When the fibres and cells which cause the memory are atrophied, memory disappears.[24] It is interesting to note that Romanes arrived at these views independent of Ribot.

Together with the other teachings of Ribot upon memory the law of regression has been generally accepted. It will appear, however, in the course of this work that it is a law to which there are many exceptions, if indeed it can be considered valid.

These views are reinforced by a series of writers, each of whom accents some particular feature. Memory is regarded as the mere organic process, an embodiment of impressions and movements in the organism.[25] How the organism is modified becomes the subject of acute speculation. One author[26] regards mem-

[24] "Diseases of the Memory." Fauth, "Das Gedächtniss."

[25] Maudsley.

[26] Dr. Henry Verneuil.

ory as an absorption by the gray cerebral matter of colours, forms, sounds, tastes, and odours, the chief agency in cerebral modification being electric currents. Again, the purely physical action of the nerves is considered as transformed into nervous vibrations and absorbed by the organism.[27] This higher form is wholly *sui generis* and constitutes a phosphorescence. One of the earliest of these authors[28] states that apart from the power of habit in the cells of the gray matter all mental life, including memory, would be impossible. The phenomenon of forgetfulness is ably treated from the organic standpoint. Maudsley infers from a study of secondary automatic movement that we never absolutely forget anything which we have experienced. As Paget puts it, "The bodily elements never forget an experience which they have once known." In his "Conflict of Religion and Science" John William Draper writes: "In the brain ganglion of insects are collected the residua of sense impressions. The mutual interaction of the residua raises the insects above the plane of mere automata. An illustration will show how abiding is this impression. If we breathe upon a blade of polished steel, as a razor-blade, and then place upon it an object of any shape, perhaps oblong; when the moisture

[27] J. Luys in "Brain and its Functions."
[28] Jesser.

has evaporated and the oblong is removed no impression is left; but again breathe upon the blade and the oblong form reappears. If the razor be laid away for months, the impression will remain. If this be true of an organized surface, surely a brain ganglion may be permanently modified." He further considers how the residua may react upon the ideas. After discussing visual after-images, he inquires: "Are there contained, then, in the brain more permanently, as in the retina more transiently, the vestiges of impressions that have been gathered by the sensory organs? Is this the explanation of memory, the mind contemplating such pictures of past things and events as have been committed to her custody? In her silent galleries are there hung micrographs of the living and the dead, of scenes that we have visited, of incidents in which we have borne a part? Are these abiding impressions mere signal-marks, like the letters of a book, which impart ideas to the mind? Are they actual pictures, images inconceivably smaller than those made for us by artists, in which, by the aid of the microscope, we can see, in a space not bigger than a pinhole, a whole family group at a glance?"[29]

The views of the organic school become at times extravagant, but its merit consists in the emphasis which it has placed upon the fact that

[29] "Conflict of Religion and Science," p. 134.

the cerebral element must be considered. These writers have placed the study upon an empirical basis, and indicated the way to further advancement. Their contribution to the study of forgetfulness is important. The reaction against this school was represented by Rudolph Hermann Lotze, Dr. Franz Fauth, and Johannes Huber. Indeed, two philosophies of memory could hardly contrast more than those of Ribot and Lotze. The latter makes memory a function of the soul, which possesses the power of memory and recollection in itself, and does not consider the brain an organ of memory. Although the reaction of the latter is necessary, the higher powers of the mind are independent of the body. The brain cannot retain impressions of all images; for, if it could, the atom which in the image of a tree represents a green colour, in that of a flower would represent a red one, and in that of each human being would represent a different colour. In order that the soul may combine its states into a harmonious whole, like images recall like, and those images recall each other most vividly which are arranged in the same order and conform to the same plan. While each presentation tends to recall all that are associated with it, the chances of a percept being recalled depend upon the number of points of resemblance between it and the one already in the foreground of consciousness. Herbart's conflicting ideas, he says, are

mere figments of the imagination. We have to deal not with their conflict, but with their affinity. While one percept seems to be more vivid if upon reflection it acquires new properties, yet we do not possess an idea more or less clearly. We either have the presentation or it has entirely disappeared. Ideas do not gradually fade away, but, as St. Augustine and Locke taught, disappear as if destroyed. The less noticed contents of a percept disappear first and cause us to forget the entire complex of which they were parts. Lotze places emphasis upon feeling. If the common feeling which accompanies the memory be destroyed, we lose the memory.

The disturbances of memory due to disease present, he writes, the same difficulties only which occur occasionally in a state of comparative health. Wrong conclusions have been drawn because the data were carelessly collected and too little attention was paid to details. The prejudice of the observer has led to misinterpretation.[30]

In his first book, entitled " Das Gedächtniss " (published in 1888), which we have frequently cited, Fauth, like Lotze, maintained that memory is a function of the soul. More than most other writers, he emphasized feeling, particularly the feeling of a harmony of the whole,

[30] " Microcosm," vol. i., bk. ii., chap. iii.

which, as an ethical desire, induces us to complete voluntarily the partial memory. In his recent work, bearing the same title, he shows evidence of having kept in touch with the later psychological literature, but his attitude remains unchanged. On the one hand he takes cognizance of habit, cerebral localization, and modification of the brain substance by excitations; while as a psychologist he still depends upon others for his material, his description of the unconscious memory of the motor and sensory nerves gives his book an up-to-date appearance. On the other hand, the new psychology has not swept him from his moorings. He reaffirms that the soul is the bearer and unifying power in the mental processes, and believes that the retention of impressions in the nervous system does not account for all of the corresponding psychical conditions and activities. The same conservative view is held by Johannes Huber. While the soul is supported by the brain, memory requires cerebral activity plus consciousness. Reproduction belongs to subjectivity, not to objectivity, and memory in itself is an ability of the soul to retain, to reproduce, and to recognize.

That writers should arise who recognized an element of truth in each of these views was inevitable. Such a writer was Alfred Fouillée. He assumes many possible representations, which have varying degrees of tenacity to sur-

vive and to revive. These are not Herbart's reals, but conscious states correlative with vibrations in the brain. After an analogy to the Darwinian biology, the laws of memory may be termed laws of intellectual selection. The mechanism which renders possible a survival of images is: (1) a memory persisting in the brain; (2) a trace or residuum persisting in the brain; (3) a disposition persisting in the brain. Fouillée reduces all associations to similarity. Similar associations, on their physical side, are represented by contiguous portions of the brain. The renewed impression occupies the same parts of the brain as the primitive impression, and is reproduced in the same manner. The image occupies the same nerve-centre as its corresponding sensation. The physiological mechanism of association is the association of the reflex movement between the different cerebral cells by means of the fibres which unite them. For memory, such a principle is a persistent cerebral motion, which modifies the neural substance and leaves a disposition. The motion and force thus retained form the basis of habit; but in order to form a complete association, the reaction of active consciousness is necessary. Memory thus depends upon the feelings, and its strength is directly proportional to the feelings excited and to the power of voluntary movement.[31]

[31] "La Mécanisme de la Mémoire" in *Revue des deux Mondes*, May, 1885. Fauth, "Das Gedächtniss."

Fouillée's position is supported by J. J. Bier-vliet and Henri Bergson. The former attributes to the gray matter of the cortex the fixation of memory images, yet he ascribes the intelligent memory to the mind while recognition is an ability of the soul. The theory of Bergson assumes three elements in memory: (1) pure memory; (2) memory images; (3) perception. The memory images mediate between the pure memory and the bodily images. The pure memory is transcendental and reminds one of Plato's ideas. It begins to materialize in the memory images. The memory images, on the other hand, fill perceptions and complete and interpret them. While memory tends to image itself, the memory images do not tend to remember. But how are the bodily images obtained? The world is conceived as a series of images. The body, itself an image, is a centre (or mirror) which reflects upon surrounding objects the action which the objects exercise upon it. It is a microcosm reflecting the macrocosm. Some rays coming from the world images to the body are reflected and thus produce images; others pass on into the centre of indifference, or the "Zone of Indeterminism," and are lost.[32]

While the last three authors have used the splendid legacy which they received from the organic school, they do not regard its contri-

[32] "Matière et Mémoire," Paris, 1896.

butions as final. We may not be able to accept their theories as a whole, but their teachings enable us to conclude that Ribot and Lotze each may have developed one side of the truth.

Other recent contributions of worth by European writers are the studies of Alfred Binet and Victor Henri upon the memory of words and phrases, in the case of children in the primary schools of Paris.[33] The inductive work of Professor Ziehen, which will be considered under Association, Chapter VII, is an important contribution.

While only two American writers have been quoted thus far, the subject under consideration has received attention in this country during the past two decades. Our psychologists have entered upon the rich heritage already described, and their contributions are very important. Dr. W. H. Burnham's history of memory, to which repeated reference has been made, is a painstaking and scholarly work, and, so far as it covers the ground, may be regarded as the standard historical treatise. His history of memory is supplemented by a chapter upon paramnesia, and while advancing no explanation of the subject of memory, he indicates paths for further advancement by investigations along empirical lines.

Professor William James writes in his sugges-

[33] *L'Année Psychologique*, vol. i,

tive and interesting manner. Memory is conditioned by brain-paths, and its excellence in a given individual depends partly upon the number and partly upon the persistence of these paths. The permanence of the paths is determined physiologically, but their number depends upon mental experience. "The cause both of retention and of recollection is the law of habit in the nervous system." This law, as the physical explanation of the association of ideas, may be stated as follows: "The amount of activity at any given point in the brain cortex is the sum of the tendencies of all other points to discharge into it, such tendencies being proportionate (1) to the number of times the excitement of each point may have accompanied that of the point in question; (2) to the intensity of such excitement; and (3) to the absence of any rival point functionally disconnected with the first point, into which the discharges might be diverted." In order that a state of mind may abide in memory, it must continue a certain length of time. Primary memory images, to which little or no attention is given, he designates as elementary habit. Memory proper, or secondary memory, is the knowledge of an event or fact of which meanwhile we have not been thinking, with the additional consciousness that we have thought or experienced it before. The only way in which memory can be improved is

by improving the habitual methods of recording facts.

Professor George T. Ladd, in a scholarly and guarded discussion, recognizes a physical basis for the retentive power of memory. The retentive power of the nervous tissue "never loses in entirety the effect of any impression once made upon it." The power to remember, however, "is a spiritual activity wholly *sui generis* and incapable of being conceived of as flowing out of any physical condition or mode of energy whatever." He fully recognizes, however, the molecular changes in the nerve-cells due to repeated action and habit. While he rejects the term *organic memory*, he extends the application of the term *memory* so as to include memories of the different senses, mentioning memories of the fingers, the tongue, the larynx, etc. The physical conditions of the memory images of the various senses are located in definite cortical areas.

Professor J. Mark Baldwin conducts an able discussion, in which he states: "The fact of retention is due to a physiological disposition. The facility of reproduction depends upon the strength of this disposition." By repetition and habit every act becomes more easy; and as a result "consciousness accompanying the act is less vivid." On the psychical side mental habits are formed which may become stronger than the physical. On the subjective side memory

is an association of images. He emphasizes apperception. We remember the groups of complexes as they were apperceived; hence the kinds of relations involved in apperception serve to distinguish the memory images as local, temporal, and logical. A résumé of his views concerning interest will be found in the chapter upon Attention.

Professor Dewey, in his well-known "Psychology," also emphasizes apperception: "As apperception is the reaction of the self with the character given it by past experience upon the presentation, so retention is the reaction of the content thus apperceived upon the self." There are memory images, but all remembered experience has an ideal character only. Like perception, it is the active construction by the soul of certain data. While rejecting all physical explanations, he recognizes the close relations existing between memory and perception, of which it is the outgrowth. The image may be recalled by association, or voluntarily through interest and attention.

Professor Donaldson, from a biological standpoint, has contributed much material which is rich in pedagogical application. Frequent reference will be made to his writings.

In his recent book entitled "A Primer of Psychology," Professor Titchener conducts a thoroughly modern discussion upon memory, a brief summary of which is: The law of memory

is the law of association, and the latter is explained by habit. It is not the mind but the brain cortex that is retentive. The words retention, reproduction, recognition, recollection, and memory are the inheritance of a psychology that conceived of the mind as a living creature. While we have outgrown this and kindred views, we will retain the terms as part of the science, but we must reinterpret them.

With the development of psycho-physics, painstaking and laborious investigations have been made upon the memory. Ebbinghaus led the way by a series of experiments upon himself which covered a period of two years. From the simple consonants and the eleven vowels and diphthongs of the German language he formed about 2300 nonsense syllables by placing a vowel between two consonants. The syllables were then thoroughly mixed and formed into series of varied length. These syllables were repeated aloud until he could voluntarily recall them. The recall was considered accomplished when he for the first time, after the first syllable had been given, without cessation, in a definite time, was able to repeat the series, being conscious of freedom from errors. After a series was read the first syllable was repeated, and he tried to repeat the series. If he hesitated, the remainder was read, and he began again at the beginning. The plan was to read 150 syllables per minute and in a uniform tone. The results,

briefly stated, were as follows: A proportionately longer time is required to learn a long than a short series. As a rule, six syllables could be repeated after one reading; but much less frequently seven and only occasionally could eight be repeated. Only about one-tenth as many repetitions were required to remember a connected stanza of "Don Juan" as to memorize a like number of nonsense syllables. About one-third of the labour is saved by the repetition of the previous day. Three repetitions to-day save one to-morrow. The process of forgetting is rapid at first, but later goes on more slowly. After twenty-four hours, two-thirds of the original labour must be performed in order to repeat the series, while after six days, three-fourths, and after one month, four-fifths of the original labour must be repeated. A long series is more strongly impressed upon the mind than a short series. Thirty-three and one-third per cent of time is saved by association by contiguity. The value of mediate association is seen; ten and eight-tenths per cent of time was saved when one syllable was omitted, and when seven syllables were omitted there was a saving of three and three-tenths per cent. Thus, there is seen to be a relation between the first and eighth syllables over the heads, so to speak, of the intervening seven. He found that there was an association and saving of time when the series were repeated backwards. The influence of rhythm was marked

If a series was recalled in a short time, the next one usually required a relatively longer time.[34]

G. E. Müller and Schumann repeated the experiments of Ebbinghaus. They had the advantage of several persons acting as subjects, and their experiments extended over a space of five years. They found that a syllable series could be learned more easily (1) if two or more successive syllables have like initial consonants; (2) if two syllables rhyme; (3) if two successive syllables or the initial syllables of two successive rhythms have the same vowel or diphthong; (4) if the beginning consonant of the first syllable and the end consonant of the second syllable of a rhythm, or the end consonant of a syllable and the beginning consonant of the next syllable, are the same; (5) if two or more syllables form a word. On the other hand, consonants difficult to pronounce and an accumulation of diphthongs impeded the act of memorizing. A series in the trochaic rhythm is memorized more easily than a series in the iambic rhythm.[35]

H. K. Wolfe experimented upon memory for tones, using as a standard a tone continued one second. After a given interval, a second tone, definitely higher or lower, was produced, and the subject judged whether it was the same as

[34] "Ueber das Gedächtniss." Professor W. H. Burnham in *American Journal of Psychology*, vol. ii., p. 587 ff.

[35] "Experimentelle Beiträge zur Untersuchung des Gedächtnisses."

the first. His ability to answer correctly was determined by the length of the time interval, but there was only a slight decrease whether the interval was one, two, or three seconds.

Professor Hugo Münsterberg of the Harvard Psycho-physical Laboratory has conducted experiments upon different sense memories and attention. Some of the results of his investigations will be utilized.

Professor E. W. Scripture of the Yale Psycho-physical Laboratory, in his " New Psychology," pleads that the study of memory be made an exact science, and recommends the psycho-physical method of investigation.

Mnemonic systems, so well developed by the ancients, have been considered a detriment,[36] or have been developed chiefly on lines laid down by Cicero and Quintilian. Certain additions have been made, such as the substitution of consonants for dates and definite historical events, which, by supplying appropriate vowels, form concrete words and phrases. Dr. Pick emphasized the value of attention as well as of association between two concepts only at a time. The value of such systems will be considered in the last chapter.

In this historical review we see that memory has occupied the attention of great writers in every age. Almost every civilized land has con-

[36] Kant and Huber.

tributed to the subject, and, it may be added, has been represented by men celebrated for their memory. If the views of the ancients were crude, the defect was due to a mistaken philosophy, or, as with St. Augustine, the discussion afforded merely a basis for theological views. Among the permanent teachings of the Greeks and Romans are the laws of association as announced by Aristotle and the mnemonic systems. Subsequent discussions show that they were right in attaching prime importance to the subject of association. The long period from St. Augustine to Locke and Descartes was occupied with efforts to train the memory, not in investigating its nature. In the eighteenth century we find the physical side, previously noticed by the Stoics and Epicureans, receiving further attention, which prepared the way for the later organic discussion. While the movement slumbers for a century, the subject receives a closer analysis, and is developed on the psychological side by the Scottish and the English Associational schools. From this time forward the discussion as to whether, and in how far, the memory has a physical basis forms a fairly constant feature. The fuller recognition of a physical basis came late, for until 1870 this element was either rejected or received slight attention. Finally, the history culminates in an heroic series of psycho-physical experiments which have given definite and exact, if

not voluminous, results. Professors Ebbinghaus, Müller, and Schumann are still engaged upon some feature of psycho-physical investigation of the memory. If Professor James is rightly quoted as saying that the chief work of empirical psychology is to determine the relations between brain and mind, this question, as in the past, promises to be the storm-centre of interest for decades to come. Not all of the writers have been mentioned, nor has the compass of our work enabled us to treat all who have been considered as fully as could be desired; but the essentials have been given with sufficient detail to orientate the reader, and, as we hope, to stimulate further study.

CHAPTER II

BIOLOGICAL ORIENTATION

O memories!
O past that is!

GEORGE ELIOT.

WE have already found the belief occasionally expressed that man shares the power of memory with the lower animals. While no investigation had been made to determine the range and limits of memory in lower forms of life, Locke ascribed the ability to birds, and Aristotle states that only those animals which have a sense of time can remember. The question arises how low in the animal scale the mnemonic ability can be definitely traced. We must consider, moreover, the conscious memory as supplemented by an unconscious organic memory, which, as a heritage, is bequeathed from generation to generation. Each kind of memory has its function. If the conscious memory is of supreme importance as a basis of all mental activity, the organic memory renders the young fit to take up the struggle for existence, inasmuch as without education or training the organism remem-

bers how all past generations acted to conserve life. We shall, therefore, refer first to a class of animal experiences which can be regarded as conscious memory; a description will then be given of memories which may be considered conscious or unconscious according to the hypothesis which we may adopt as to what constitutes a conscious experience. Lastly, the view of racial memory held by Hering, Haeckel, and others will be considered in the light of a large number of instinctive reactions.

It is a matter of common belief that the higher animals possess some power of memory. Indeed, most people have observed instances similar to the well-authenticated examples here given. It is hardly necessary to substantiate Mr. Youatt's statement that a horse never forgets a road along which he has once travelled. The writer remembers an aged horse which when ten miles from home tried to turn upon the cross-road to the home of a friend. He evidently remembered that this was a shorter route than another into an adjacent county where he was sometimes driven. In recent years my horse remembered well for a space of two years the road which led to his early home. Dr. D. E. Phillips informs me that a two-year-old colt was purchased by a farmer who lived at a considerable distance. After the lapse of three years he returned unaided to his birthplace. A horse, after being kept on the farm for three

years and never being over ten miles away, one night left, taking a colt two years old with him. "I heard of their direction," Dr. Phillips states, "and followed them forty-two miles across the mountains. They had gone straight on without stopping. It was ascertained that the older horse (about seven years of age) had been raised and kept until four years old, four miles beyond where they were caught, and had been taken over the same route three years previously." Mr. H. J. Wood reports to me some observations upon the memory of horses: A blind horse was being driven past the house of a former owner. He showed plainly by his actions that he wanted to stop and turn in. A horse at work in the field, if struck or jerked, will often jump when he comes to the same place again. The horses generally showed eagerness when they heard the dinner-bell. One horse often answered the call of the dinner-bell by whinnying.

An unruly cow will recollect for a long time the defective portion of the fence. Gentry relates that a cow which manifested great affection for her master refused to leave the field when the other cattle broke out into the corn, or better pasture. Finally, the owner dehorned her together with the rest of his cattle. After this she was sullen and her whole disposition changed. A herd of cows had seen a certain butcher come into the barn several times, taking a calf away with him each time. Finally, the cows would

begin to bellow whenever that particular man came near. Dr. D. E. Phillips writes me: "We used to drive cattle thirty-five miles to a mountain for grazing in the summer. They remained in the woods until fall. When started on the road home in the fall they never left it, even when they had been over it but once. When spring came again, the same cattle would usually travel the same road without a mistake, although much of the way was a winding path."

The memory of the elephant is tenacious. Romanes cites the case of one which, having been trained four years, subsequently ran wild fifteen years, but at the expiration of this time recollected his old command; both psychical and organic memory seemed to have shared in the experience. Captain Shipp fed an elephant bread, butter, and cayenne pepper. After a period of six weeks he visited the animal, and being kindly received supposed his experiment was a failure; but watching his opportunity, the elephant filled his trunk with dirty water and drenched the captain from head to foot.

That a deer or fox when pursued should attempt to conceal itself among a herd of cattle is apparently more than instinct. Monkeys do not as a rule manifest so high a degree of memory as do the dog, the horse, and other animals supposed to be less closely related to man. They are, however, imitative, and, as all the world knows, are susceptible of training. Two years ago I ob-

served in the Boston Zoölogical building a gorilla named "Joe." He would, at command, put on a sweater, a cap, whiskers, and other articles. Then, when any order was designated, he would take them off, one at a time, as he was directed. Hudson observed a chakar kept in the house as a pet which was friendly to all except the man who had a swarthy beardless face. It was supposed that the animal associated him with the savages who had destroyed his early home.[1] An armadillo which had been thoroughly trained was frequently led about by a string. At the sight of his fellows in the field, however, an uncontrollable desire arose to enter the old habitation.[2] Romanes raised some ferrets under a hen. They were taken away from their foster-mother when quite young. When presented to another hen their hereditary instincts prompted attack, while their individual associations inhibited the prompting. "And eventually, although the hereditary instincts prevailed over the associations formed by the individual experience, the prolonged hesitation proved that the latter exerted a strong modifying force." Such experiences lead us to agree with Charles Darwin, who writes: "It is almost superfluous to state that animals have excellent memories for persons and places." As is well known, turkeys count their

[1] Hudson, "The Naturalist in La Plata."
[2] Hudson, "Idle Days in Patagonia."

eggs, and if two or three be taken will not return to the nest. If, however, china or other eggs replace those removed so as to make the bulk the same, they will return. They undoubtedly remember the shape and size of the nest. Lloyd Morgan writes in "Habit and Instinct": "To some chicks I threw cinnabar larvæ, distasteful caterpillars, conspicuous by alternate rings of black and yellow. They were seized at once, but dropped uninjured. The chicks wiped their bills, a sign of distaste, and seldom touched the caterpillars a second time." Bucklin gives an account of a pigeon which remembered the voice of its mistress after an absence of eighteen months. Winton, in "American Ornithology," states that a crow remembered a person after an interval of eleven months.[3] The young eagles which are taught by the parent bird to catch prey are apt pupils; but there seems to be an intellectual element in the imitation. It may be deferred instinct; but Professor Baldwin places much emphasis upon the part which imitation plays in all intellectual life. It is difficult to decide where the instinct of defending the brood manifested by the mother partridge and plover should be classed. Lloyd Morgan thinks it approaches very closely to the intellectual, and a recent experience leads me to place it among the psychical memories. Last fall I came upon

[3] Romanes, "Animal Intelligence."

a large flock of partridges. The old bird flew half a rod or so and lighted in a clump of bushes. Although out of sight, she clucked and made a noise as if repeatedly falling. While looking towards her, the entire brood, half grown, flew away, and then the mother bird could nowhere be found. The partridges are much wilder in the last part of the hunting season than at its beginning. It is well known that after migration swallows frequently return to the old nest occupied a year before. It is possible that an individual remembrance of locality forms a considerable factor in migration. Having chosen a particular place for nidification, there is a tendency to return consciously to the same. On the whole, the topographical memory of birds seems to be well developed. If we now stop to inquire how low in the scale the conscious memory can be traced with certainty, we may not go further with entire unanimity. If we hold with Haeckel and others that a considerable degree of development of the nervous system is necessary before consciousness appears, we cannot with certainty ascribe a conscious memory to forms of life lower than those already considered. If, on the other hand, we believe with Lewes that consciousness is coextensive with the entire nervous system, we can safely trace a conscious memory much lower in the animal scale, while President David Starr Jordan speaks of a plant as possessing the power of thought.

In Chapter V a theory is advanced to explain the nature of memory, which harmonizes with the teaching of Lewes and Pflüger. If this hypothesis be probable, we may extend our observations considerably further with a reasonable degree of assurance that a conscious memory exists. It is quite probable that reptiles, toads, and fishes have a sense of locality. Possibly reptiles have a higher memory. It is well known that some men will twine snakes around their necks with impunity. The usual explanation is that the poison has been removed. But Menault has cited cases in which a snake would turn a moment later and inflict a deadly wound upon a dog.[4] Mr. Bell, the English naturalist, tamed a water-snake so that it could distinguish him from strangers. It would receive him kindly, but would hiss and fly at strangers.[5] As will be seen later, the memory of the snake is about on a par with that of fishes. Professor E. W. Bohannon gives me the following instance of the memory of a toad: "When a boy we had a spring-house in which milk was kept. A wet cloth was spread over the vessels which were not very high, to keep out the dust and insects. A large, healthy toad found the place very cool for hot summer days, and was not disturbed until he began to jump upon the cloth covers and to push them

[4] Romanes, "Animal Intelligence."
[5] Cited by Gentry.

down into the milk. We carried him away many times, but he always returned very soon thereafter, until he was taken a distance of more than half a mile." Frogs when taken a considerable distance from their haunts will return frequently. Yet in the latter case an unusual sense of moisture may aid the memory, if indeed it do not constitute the chief cause.[6] The razor-fish, if alarmed upon coming to the surface, will not appear again for a long time, even on account of the application of irritants.[7] The historic carp in the pond of the palace at Fontainebleau, it is reported, will pass a piece of apple thrown to them in disdain, feeling assured that they will never be able to masticate it, but will wait with great patience while the hardest bread becomes soft in the water, knowing by past experience it will soon be in a condition to serve for their food. Fish frequently resort to the same locality for spawning, but this may be due to accident. Lacépède relates that in many parts of Germany trout and carp are summoned to their food by the sound of a bell.[8] This statement is verified by other observers. Every angler of the speckled trout knows how much less shy the beauties are on the first of May, when the law has just ceased to protect them, than later in the season when they have learned by experience

[6] Gentry.

[7] Romanes, "Mental Evolution in Animals."

[8] Cited by Gentry.

to fear the hidden hook. The pains that fishermen take to use various coloured flies implies a widespread popular belief that fish distinguish between colours. Moebius relates that a pike was separated from some small fish by a glass plate. At first he hurled himself furiously against the invisible obstacle and was almost killed by the violence of the shock. Little by little his eagerness ceased, and at length he left the little ones alone. At the end of three months the glass plate was removed, but, strange to say, he did not touch the fish, but was ever on his guard against the obstacle. He recollected that he had suffered without an appreciable cause. Earwigs and spiders, if fed regularly, learn the locality in which their food is placed.[9] Beetles profit by experience sufficiently to coöperate in their labour. It is difficult to state where the psychical memory of spiders begins. The flat-webbed spiders which wait just out of sight for some insect to light on the web, and, if the object be too heavy, release it, apparently show some higher power than organic adaptation. Gentry has noticed that the Lepisma (book-lovers), when disturbed, know where to find a place of security with the least possible expenditure of time and energy. The myrmeleon or ant-lion (you-ee-up) which digs a burrow in the sand and sinks to the bottom of it, leaving only the tips of its

[9] Gentry, "Life and Immortality."

mandibles in sight ready to seize an insect—like the spider, which gains its food in a similar manner—cannot owe its memory wholly to racial experience. Herr Edinger, the German anatomist, relates that a young schoolgirl kept a fine, large caterpillar in a box and fed him carefully on choice leaves. At first when it was necessary to remove him, he immediately curled himself when placed upon a leaf, but in a short time, learning that no harm was intended, he remained stretched out. Whenever a stranger touched him, he at once curled himself as before. Erasmus Darwin records that a wasp divided a large fly into parts and flew away with a section at a time. This incident apparently shows remembered experience. Sir John Lubbock, quoted by Romanes, found that three lessons sufficed to teach a wasp the memory of an open window. Bees remember where their hive is when it is located among many others. They remember for months where they obtained honey and sugar, and will, when occasion requires, return to the old nest or hive a year after they have deserted it. They also recollect where distant basswood and clover blossoms are. Professor Edward Hoffer found that humblebees remembered their old nests, three miles distant, after a day's absence; at other times they returned after being carried nine miles; others manifested a good memory after six months' absence.[10] In some of the instances

[10] *Science*, vol. vii., p. 3.

recorded of the memory of ants there is room for mistaken interpretation, but after all deductions are made there is probably a residuum to be explained by individual memory. Romanes has collected many examples in " Animal Intelligence " which, allowing for error in observation and when interpreted in a conservative manner, indicate a psychical memory. He writes: " Little need here be said that ants display some power of memory. . . . When an ant finds her way to a store of food . . . she will return again and again. . . . The nature of the instinct memory appears to be, as far as it goes, precisely identical with that of memory in general. Thus a new fact becomes impressed upon the mind by repetition, and the impression is liable to become effaced by the lapse of time. . . . Sir John Lubbock found it necessary to teach insects by a repetition of several lessons their way to treasure if that way were long or unusual." Ants recognize other members of the colony after a long absence. When separated from the colony four months, and even a year, they are at once pleasantly greeted upon their return, when a stranger would have been killed. Sir John Lubbock found that larvæ when removed and returned to the nests as full-grown ants were immediately recognized. I am not certain, however, whether a peculiar smell or other data did not aid the memory or even constitute the chief factor in the last example.

Schneider writes: "The higher mollusks and cephalopods show unmistakable traces of memory." An octopus, he relates, manifested a memory for its keeper. He describes a contest between an octopus and a lobster. After the battle they were put in adjacent basins, and, during the night, the former crawled over the wall which separated them and killed the latter. The psychical development of the creature left no room for doubt that the action was purposeful.[11] The fiddler or calling crabs may be busy at work, but if a person draws near them they at once repair to their dwellings. Moreover, they foster in memory the lingering smart arising from old feuds and battles.[12] Mr. Lonsdale observed a snail (*Helix pomatia*) which, after losing its mate, crawled over the garden wall, but returned the next day to the place where it met with the loss. The limpet apparently has a memory for locality. After a browsing excursion it returns to its hole in the rock. This might be explained as a habit grafted on instinct, but there would seem to be a residuum of consciousness. Darwin writes: "Even the headless oyster seems to profit by experience."[13] Romanes believes that as a result of experience they learn to keep their shells closed more carefully against enemies when in the beds, than do uneducated oysters more re-

[11] "Der thierische Wille."

[12] Gentry, "Life and Immortality."

[13] Darwin's manuscript, cited by Romanes.

mote from danger. Those who raise oysters believe that the latter are amenable to education and improve by experience. A civil engineer is reported to have asked a workman why he kept a large number of oysters on a declivity, as they were dry at low tide. The reply was, they are being taught to economize the water in their shells; in short, becoming educated. Oysters immediately from deep water are apt to open on the road. If they are first placed where they are alternately under water and dry, they learn in a few days that they will experience discomfort if they open under the latter conditions, and will wisely retain the fluid. Earthworms possibly have a tactile memory; for, having drawn an object close to their burrows, they take hold of it to the best advantage to drag it into the opening. Darwin placed one hundred lime-leaves, "basal margin of blade broad, apex acuminated," before earthworms. Eighty were drawn into the burrows by or near the apex, eleven by or near the middle, and nine by or near the base. One hundred pine-tree leaves were all drawn in by or near the base.[14] This power of selection may be due to individual experience.

The starfish possibly remembers locality, for if removed from its eggs it will crawl back to the place where they were.

So far we have considered a memory like in

[14] "Formation of Vegetable Mould," p. 90.

kind and differing only in degree from that of man. While the examples have been carefully selected, we are conscious at every step of a difficulty with which comparative psychology ever meets, viz., Is the phenomenon a mental activity or have we read into it our own thoughts ? Although conscious memory has been ascribed, perhaps rightly, to vorticellæ, we must be guided in the comparative study by the following principle of C. Lloyd Morgan: " In no case may we interpret an action as the outcome of a higher, psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale." In most, perhaps in all, of the examples thus far used, the best interpretation seems to be to assume a memory like our own, i.e., the same in quality, but of low degree. That the difficulty of interpretation increases as we descend the scale of being is evident, and one can hardly fail to note that the higher and better developed memory accompanies a more highly developed brain and nervous system. If, however, a conscious psychical memory can be traced no further, there are, as already intimated, other memories which remain to be considered. The hypothesis of Hering that memory is a property of all organic matter is a theory which has produced a strong impression, yet we cannot state that it has been generally accepted. Objections have been raised, particularly by American psychologists, to using

the term memory in this relation. Since both Hering and Haeckel arrived at their conclusions deductively, an inductive study may enable us to arrive at an intelligent judgment of the hypothesis. The reader will bear in mind that we are now dealing with an *unconscious or racial memory manifested as an instinct.*

It is difficult to define instinct, if indeed a definition be possible. In using the term we refer to an inherited aptitude to act in a definite way. This ability comes without teaching and "without individual experience upon which intelligent choice of the best mode of procedure can be based," yet the animal acts as definitely as if a choice could be made. The actions and habits are inherited, and are to be distinguished carefully from those organic habits which, as secondary automatic memories, are acquired during the lifetime of the individual. The playing of a musical instrument by a virtuoso is a more or less reflex process, but it is acquired by the individual and is not innate. We have now to deal with a congenital ability conserved in the organism of successive generations, and which, therefore, belongs to the race. Herbert Spencer regards instinct as a development of reflex action. He states: "The higher the instinct the more complex are the directing and executive coördinations," and a special combination is perpetually repeated by every individual throughout life. Early in the child's life

congenital activities become evident. Preyer found that the taste of sweet is preferred at the very beginning; if before it took food the infant's tongue was moistened with sweet milk, it seemed to experience satisfaction, but the reverse was true when quinine, salt, or vinegar was substituted for the sweet. Professor James enumerates the following human instincts: sucking, biting an object placed in the mouth, clasping an object and carrying it to the mouth, crying, smiling, turning the head aside as a gesture of rejection, holding head erect, sitting up, standing, locomotion. Drs. Ellis and Hall found that the instinct for dolls is almost universal. President Hall, after a critical and painstaking study of the instinct of fear, writes: " Not only does every one fear, but all should fear "; fear forms the mainspring to a " wealth of motive," and lies at the root of many of the strongest intellectual interests. In order that the instinct may not be lost, a habit must be grafted on the inherited tendency. A calf has an instinct to follow in a tame manner, but if it see no one for three or four days, it becomes as wild as a hawk. Spaulding hooded some young chicks, which at the time showed no fear, for three or four days, at the expiration of which time they manifested fear. If they had been unhooded a day or two before, they would have followed without fear. The higher animals have well-fixed organic habits which Darwin thought of as racial memories.

He notes that when dogs wish to go to sleep on the carpet or other hard surface, they generally turn round and scratch with their forepaws in a senseless manner as if they intended to tramp down the grass or scoop out a hollow, as no doubt their parents did when they lived on the grassy plains or in the woods. Jackals and other animals treat their straw in like manner When two dogs meet in the road, he writes, the one which sees the other first, though at a distance of one or two hundred yards, after the first glance always lowers his head, generally crouches a little, or even lies down. Thus his ancestor conducted himself in getting ready to rush upon his prey. Again, he writes, when a horse threatens to bite his groom he lowers his ears, hugging them close to his head. This is of no possible advantage to him, although it was an advantage to his ancestors when fighting with others of their own species. Certain actions of animals, which all farmers observe, apparently are congenital. The sight of blood throws horses into consternation, and cattle into rage. In slaughter-houses it is said the smell and sight of blood puts the ox in agony before he receives the death-blow. Perhaps an analogous racial experience is seen in the rage which a red cloth excites in a turkey or a bull. Either the red cloth is associated with blood, or, as Hudson believes, all animals are affected by bright colours. The tendency of cattle to conceal their young, and

of both cattle and sheep to avoid the dew by standing under trees, is undoubtedly due to racial experience. Apart from instinct, it is difficult to explain the ability of the ass to carry the traveller in safety along the edge of the precipice. The man described by Horace could hardly be blamed for pushing his donkey off into the valley below, although by the act he destroyed his own property. The dying instinct of the huanacoes described by Hudson furnishes a remarkable example. When about to die the huanaco goes to the ancestral cemetery, where lie the bones of countless generations, and there breathes its last. Here, where at some time it may have proved advantageous for the race to die, the animal invariably comes to suffer the death-pang—a fit theme for the artist. The experience is best regarded as an inherited tendency, and we have no warrant for ascribing it to conscious memory. It is closely associated with the homing instinct of pigeons. Hudson observed riding-horses which had known nothing but cruelty from man, coming home from the plains to die. In the latter case the instinct may have originated in another instinct—that of animals to persecute the weak. The latter, Hudson regards as a perversion of the instinct to rescue. So interwoven are the threads of organic life and habit.

The instinct to kill, common to ferrets, weasels, and feral dogs, is not shared by the lion and

the tiger, which kill only to satisfy hunger or in self-defence. The cat and the lion possess a congenital desire to tantalize their helpless prey. Then there are the animal toilets described by Cornish. "Brushes and combs most animals carry with them." "Brilliantine is also carried . . . by all ducks and divers; mud serves all for cream and vaseline, dust for fuller's soap and hand-powder; and water, as with us, is perhaps the most necessary." Sparrows use road-dust, and, as every hunter knows, the partridge bathes in loam. Wild ducks near the salt water prefer to bathe in fresh-water pools. Sparrows and robins bathe each morning. The cat, the tiger, and the lion clean their bodies in the same manner. Dogs use a bush, haystack, or other projecting surface for a towel. Cattle, as well as horses, aid one another in making the toilet. That the toilet instinct is congenital seems probable. "A magpie about five weeks old, which he had reared from quite an early stage of its life, when placed in a cage and supplied with a pan of water made one or two pecks at the water, and then outside the pan, without entering the water at all, proceeded to go through all the gestures of a bird bathing, ducking its head, fluttering its wings and tail, squatting down and spreading itself out on the ground." [15] Animals are not only cleanly, but care is taken to preserve the health. The

[15] Charbonnier, quoted by Lloyd Morgan.

deerlicks indicate the medicinal properties of salt, which is also used by carnivorous animals.[16] Dogs eat spearmint, and the word catnip is significant. Pheasants and wild turkeys eat hot arrowroot in place of pepper. The death-feigning instinct is a strange phenomenon. Certain insects simulate death and will suffer exquisite torture without moving. The fox when overtaken by hounds may resort to this refuge, and sometimes, by this means, escapes death. This tendency of the opossum has passed into a metaphor, if not a proverb. The cause of such conduct is probably best explained as paralysis due to fear. But in the Quantrell raid one victim saved his life in this way. The fact that the ruse is resorted to quite frequently in border warfare looks like reversion to this instinct. Paralysis, however, apparently plays a large part, as in the act of the snake which charms its prey.[17] Torpidity during winter months is a habit acquired at first possibly by necessity, and which is bequeathed from generation to generation as an unconscious automatism. Some species of snakes congregate in large numbers for this purpose, reminding one of the assemblage of birds for migration. The building instinct of the beaver needs only to be mentioned. Cornish describes an otter which had some dry straw in its house on a bridge.

[16] Cornish, "Animals at Work and Play."

[17] Swainson, "Habits and Instincts of Animals."

Other straw lay upon the edge of the bridge, dipping into the water. Instead of carrying it directly from the edge of the bridge, he instinctively took to the water, swam under the bridge, gathered up a mouthful, and swam back to the starting-place, thus carrying the straw dripping with water to his bed. On account of its great variety of forms, the racial memory of birds is most interesting. Morgan, Spaulding, Preyer, and other writers have studied the instinctive habits of young birds. In some cases the instinct is immediate at birth, but Morgan recognizes deferred instincts which develop later. The instinct of pecking is a "definite congenital activity and one, be it noted, which involves nicety and complexity of coördination." There is a tendency to stop a little short of the distance. "But the young birds only strike at objects which are within striking distance. They have not to learn this distance by experience." [18] Of the birds which Morgan observed, the partridge pecked earlier and with better aim than the others. Plovers were slow to peck, and their coördination was poor. Ducklings "peck easily and with fair aim, but they do not seize and swallow so readily." A young pheasant did not peck at the egg-yolk held in front, but "followed with its head every movement of the object in a narrow circle about two inches in front of its beak.

[18] Lloyd Morgan, "Habit and Instinct."

Simple as the action seems, it shows a striking example of congenitally coördinated movements accurately related to movements in the visual field, the whole performed without any possibility of learning or practice, and less than half an hour after the bird had first seen the light of day." As to the warning cry, Morgan writes: "I am inclined to believe that the warning cry evokes a truly instinctive response." There is no doubt about the instinct of fear in birds. That it becomes as definite as the fear of a hawk may be doubtful. Spaulding observed that a turkey ten days old, upon hearing the cry of a young captive hawk, stood motionless, and when the hawk gave a second cry it darted out of an open door and crouched in the corner. Morgan is inclined to credit an instinctive response to any sharp or unusual sound, but not a definite response to the cry of a particular enemy. The cuckoo is interesting as a pirate. The English cuckoo carries its large number of small [19] eggs to the nests of other birds. When the little cuckoo hatches, while blind, it lies on its back and works the other fledglings out of the nest. Here large size is a factor. But an instinctive purpose seems to constitute an element in the process. The foster-parents carefully feed and rear the young robber, which in turn will devastate other homes to rear

[19] The eggs of the American cuckoo are larger, and its hereditary instinct is less fixed.

its own. The instinct of other birds to care for the young cuckoo is perhaps as well defined a habit as that of the cuckoo itself. Couch observed canaries and other birds flitting around a cage which contained young cuckoos in order to feed them. Perhaps no instinct of birds is more fixed and persistent than that of migration. The movement is begun instinctively, but when once under way experience and tradition may enter in as important factors. It is, moreover, a very general instinct. "Every bird of the Northern Hemisphere is to a greater or less degree migratory in some part or other of its range."[20] They cover vast distances in flight. "The sanderling nests in Iceland or on the shores of the Arctic Ocean, and in winter it has been seen as far south as Cape Colony. The nestlings of the knot have been found in Grinnell Land in latitude 82° 33′ N., and the bird is known to winter as far south as Australia and New Zealand. The turnstone is a great traveller, nesting in Greenland or on the coast of Scandinavia and wintering in Australia, New Zealand, South America, or Africa. The distances travelled amount sometimes to over 7000 miles. The American golden plovers are bred in the Arctic regions from Alaska to Greenland, above the limits of forest growth, and when autumn comes

[20] Professor Newton's "Dictionary of Birds," cited by Lloyd Morgan.

they pass through Nova Scotia, strike boldly out to sea, and, generally leaving the Bermudas well to the west, sail over the ocean till they reach the West Indies. . . . From Nova Scotia to Hayti, the nearest West India island available, is 1700 miles." [21] We are well acquainted with the semi-annual migrations of geese. They meet together preparatory to departure, and divide into two lines which unite in a point like a V reversed. The leader is at the apex, but occasionally when one leader tires another is chosen. The purpose of the V formation does not seem to be so much to cleave the air as that each may keep out of the way of the others. If a strong wind be blowing, one line of the V may be lengthened, or they may form in closer array. In a very strong wind the V formation is abandoned. Pigeons formerly migrated in very large flocks, yet the flight was orderly. Linnæus observed that the female chaffinches migrate from Sweden in the winter, while the males remain behind. Much has been written upon the definite routes of migration, and the opinions upon this subject are not unanimous. Palmén maps out routes as definite as are natural or political boundaries. Morgan evidently considers this topic with reserved judgment. After all deductions have been made, however, there appears to be a residuum which should be considered.

[21] Lloyd Morgan, "Habit and Instinct."

The route of the plovers is fixed over sea and land. In general, the southern route is taken in the winter as the one in the direction of less cold and of longer days. The silktail originally migrated south, but later took up a permanent abode in Germany. Birds which [22] migrate by way of the Mediterranean, says Dr. August Weismann, make the passage by a few definite places. (1) On the west by the Strait of Gibraltar; (2) from Tunis to the southern point of Sardinia, over Sardinia and Corsica to the coast of the Gulf of Genoa; (3) from Tripoli over Malta and Sicily to Italy; (4) a route in the east of the Mediterranean, from Egypt by way of Cyprus. That these routes are not chosen solely because they necessitate a shorter continuous flight is seen from the fact that the birds do not always take the shortest path to the island. For example, the distance from Tripoli to Malta is twice as great as that from Cape Bon, near Tunis, to the western point of Sicily, and it is the route which subjects the birds to the most perilous storms. The real reason, according to Weismann, why this route is chosen is that in the Diluvial period land connected the continents at the Strait of Gibraltar, and a strip of land extending from Italy to Sicily and the coasts of Africa divided the Mediterranean into two seas. Before this

[22] "Wanderungen der Vögel," by Homeyer and Palmén. (See map of Migratory Movements appended.)

land sank, many thousands of years ago, it was the general migratory route and has been retained as such to this day.[23] It is difficult to read this description without thinking that the birds have remembered the route or routes. Mr. Frank M. Chapman in his recent work [24] writes: "The bobolink, an eastern bird which, breeding from New Jersey northward to Nova Scotia, has spread westward until it has reached Utah and northern Montana; but—and here is the interesting point—these birds of the far West do not follow their neighbors and migrate southward through the great basin into Mexico, but, *true to their inherited habit*, retrace their steps and leave the United States by the roundabout way of Florida, crossing thence to Cuba, Jamaica, Yucatan, and wintering south of the Amazon. The bobolinks of Utah did not learn this route in a generation; *they inherited the experience of countless generations slowly acquired as the species extended its range westward*, and in returning across the continent they give us an excellent illustration of the stability of the routes of migration." "They furnish, too, an instance of one of the most important factors of migration, that is, the certainty with which the bird returns to the region of its birth." (The italics in the above quotation are my own.) If Hering had never

[23] "Wanderungen der Vögel."
[24] "Bird Life."

written, we might say that these experiences bear a strong analogy to memory, if they be not memory itself. There is by no means unanimity in the analysis of the elements which enter into instinct. Its full significance may never become known. An impulse to leave at a given season has been mentioned. That this is innate cannot be doubted. Once under way, as we have stated, tradition plays a large part. It does not, however, seem adequate to explain all. Lloyd Morgan hazards a guess that " while the migratory impulse is innate and perhaps there is an instinctive tendency to start in a given direction, yet the element of traditional guidance may be effectual in the migratory stream as a whole, in some way that we have hitherto been unable to observe."[25] Desire for food plays a large part. Weismann has observed that it is a great mistake to assume that birds do not obtain a large supply of food in the Arctic regions. Mr. Seebohm states that millions of birds go annually to the tundra in the Arctic regions, a locality which abounds in cranberries and other berries.[26] Weismann states that some flocks of the eider-ducks remain in the temperate regions without migrating. Others, like the woodpecker, fly moderate distances as the weather compels them; while others migrate to and

[25] " Habit and Instinct,"
[26] Cited by Cornish,

from the Arctic regions by the Mediterranean routes already described. This would lead us to infer that changes in climate were a large factor in developing migration. When once begun from choice, like all habitual duties, the act was relegated to the reflex centres and the impulse to migrate was transmitted. Again, birds which winter in small islands have not room in which to rear their young. As Weismann observes, in such cases it is a choice between death and migration. L. W. Kline,[27] after a careful study of this subject, emphasizes as one element in the migratory instinct a temporary physiological condition in the organism immediately before nidification and moulting. Chapman states that with migratory birds the season of nesting coincides with the season of the year when their summer homes are habitable. All things that make for physiogenetic and kinetogenetic[28] welfare, as favourable climatic conditions, the desire and necessity for avoiding cold, desire of a longer day, food for themselves and young, a special physiological condition, tradition and love of society, are factors which constitute elements of instinct. What was at first a matter of necessity has, by repeated acts through many generations, developed coördinations of movement which have become imperative. Definite

[27] I am indebted to Dr. Kline for references and considerable literature upon the subject of Instinct.

[28] Cope.

migrating routes cannot be wholly explained by tradition. There plainly enters in what Morgan terms an unknown element. There is, it is safe to assume, a modified cellular structure which, with a corresponding aptitude, is inherited. It is easy to see how Hering, pondering the phenomena manifested by instinct, was led to the hypothesis of organic memory, an hypothesis so happy (as we shall see later) as to become widely adopted by scientific writers. In the certainty and imperative character of the migratory impulse, as seen in its universality and definiteness of routes, Hering might say that the filial cells inherit the property of the parent cells. How well coördinated these congenital movements become appears in the migration of certain land animals. The lemming of Lapland and Norway migrate in large numbers from the mountains to the lowlands. The interesting fact of these migrations is that they occur only occasionally, not oftener than once in ten years. It is believed that they migrate in those seasons in which the autumns are followed by very severe winters.[29] What is the significance of the occasional migration ? As is well known, many animals prognosticate a storm. Is it a folk-illusion that the lemming foretells a hard winter? Field-mice migrate in uncertain seasons. Before starting, they assemble in large

[29] Cornish, " Animals at Work and Play."

numbers, as do birds upon similar occasions.[30] Another occasional migration is that of grasshoppers. Their migrations which have occurred in the West are described as consisting of immense numbers which leave a path of desolation and ruin. An eye-witness described them as "dense, like a hailstorm, and in throngs large enough to obscure the sun." Butterflies also make occasional migrations. In India they have been reported as going west in vast numbers. If all migration has an element of organic modification, which may be termed elementary habit or organic conservation, the occasional migrations apparently show a greater delicacy of coördination of feelings and movements. The fiat is given, not in obedience to an habitual stimulus, but to an occasional one. Such might be the explanation of migration by the lemming and field-mice. In the other cases necessity probably induced the change of habitat. The land-crabs of the West Indies regularly migrate in the spring from their cavities in the mountains to the seacoast. They journey in great numbers and in so direct a line that nothing changes their course.[31] In Siberia, dogs hunt in packs to kill sheep, deer, and ibexes. The permanent society of animals leads us to conclude that the social instincts are a factor in migration. The instinct

[30] Cornish, "Animals at Work and Play."
[31] Swainson, "Habits and Instincts of Animals."

of bees borders upon the intellectual. By the hexagonal cell the greatest amount of honey is stored in a given space. If a strange queen enters the hive, a battle between the queens may result. If not, the other bees will kill her, not by the sting, but by suffocation—a mode of death reserved for royalty. Cornish dwells upon the fact that so many bees live together, working solely for the good of the community in a manner which does not allow the advantage and aggrandisement of individuals. This "transcends reason as we understand it."

A most interesting field of study consists in the means of defence employed, particularly those of a passive nature. Little emphasis is placed upon that most helpful of defensive resources, viz., colour, which depends largely upon food. The partridge, aside from its sudden and speedy flight, will stand perfectly still as if aware its colour so nearly resembles the ground that the hunter cannot notice the difference. The power of imitation is illustrated in the rove-beetle, which has been mistaken for a small round pebble. It had folded its head under its breast and turned its body over the wing-cases.[32] Weavil-beetles with short bodies bend the head under the thorax and fall to the ground from the plants upon which they have been feeding. Their colour so

[32] This and most of the following illustrations are borrowed from Swainson's "Habits and Instincts of Animals."

nearly resembles the ground that it is impossible to find them. A family of beetles in the African desert roll up into a spherical ball like the common wood-louse. Some caterpillars support themselves for hours by means of their hind feet only, raising the body high in the air and keeping it in a stiff, straight line, or in a curve. In this position it so closely resembles a twig that a gardener attempted to break one and became alarmed. This device protects the caterpillars against the birds which constantly search for them. Some moths assume a threatening aspect, as do spiders and wild animals. " Nearly all of the species of the rove-beetle, if disturbed, expand their jaws and elevate the body as if they intended to sting the foe. Now, the first of these defences is real, because the insect can really bite very hard; but the latter is merely to intimidate, for the abdomen has neither forceps nor sting." The hum of humming-birds, beetles and other insects during flight is conjectured to be a means of defence. Another mode of defence is concealment. Certain aquatic beetles cover themselves with mud. A small beetle that frequents chalk covers itself with the white substance. Some species of crabs cover themselves with pieces of seaweed. The hermit crab conceals itself in empty shells. In a certain family of moths " the egg is deposited on the bark, into which the young caterpillar immediately enters by forming a cylindrical cell." The entrance is

then closed by a convex covering or door fastened at the upper end, while the lower door is left open for exit and entrance. The skipping butterflies (*Hesperidæ*) roll up in a leaf so as to be completely hidden from enemies. In flying to cover, they often strike violently some leaf, making it appear that the insect is there concealed, whereas it has retreated to another passage. This movement resembles the false play made by a football eleven in order to deceive their opponents. It may be that only those insects which behaved in such ways survived, but accumulated experience must have been transmitted from generation to generation. Whether the structural modification was due to "pangemmules" or "ids" matters little. That there is a congenital experience which the larva receives ready-made, a capital with which to begin the struggle for existence, is the important feature. Moreover, as in the case of those insects which store up food for the larva which it will never see—sometimes supplying the needs of the larva with animal food, while the parent is wholly vegetarian—the experience is repeated as a congenital habit and modification of the organism. The mother starfish gathers her little brood together as a hen would her chickens. She opens an oyster by taking the latter in her arms and emitting a fluid which causes the shells to part—a very effectual organic habit for obtaining food. Very significant is the nest-building

habit of fishes. The common dace builds up eggs and pebbles in alternate layers. Its purpose is apparently to protect the eggs and to prevent them from being washed away by the stream.[33] Lamprey-eels build nests, carrying the small pebbles in the mouth, but lifting the larger stones that they may be borne down by the current. These nests, perhaps 3×4 feet in diameter, hold and conceal the eggs. The fresh-water chub builds a nest upon a semicircular plan, while the trout merely excavates a depression in the sand. The stickleback selects a site and carries thither fragments of plant in its mouth. These are woven into a kind of carpet and weighted with stones to prevent them from being washed away. "Having entwined them with his mouth to his entire satisfaction, he glides gently over them on his belly and glues them with the mucus that exudes from his pores."[34] "Sometimes walls are erected of bits of wood and straw, and a roof of the same material is erected over the chamber. The useless particles are then fanned away by his tail. In conducting this work a circular opening is preserved in the chamber." "When choosing material the fish has been seen testing its specific gravity by letting it sink once or twice in the water, and if the descent was not rapid enough finally abandoning it."[35] The

[33] Gentry, "Life and Immortality."
[34] *Ibid.* [35] *Ibid.*

tactile memory has an hereditary correspondence in the organism of insect and animal life in which a racial sense of touch is evident. The forefeet of monkeys, as well as their prehensile tails, possess a delicacy of touch due to long experience.[36] Herbert Spencer considers that the rudimentary eye is a development from touch, and in its initial stages was anticipatory of touch. In such an eye visual impressions are habitually followed by tactile sensations as of seizing of food. "A nascent sense of sight, therefore, implies a nascent nervous communication, and along with nascent nervous communication we may see the first illustration of growth of intelligence." The adjustments and coördinations of Cœlenterates do not vary in their activity from generation to generation. Gentry speaks of a Cœlenterate as "Groping about with its flexible arms, which are closely invested with jelly hairs, with which it seemingly feels, its tentacles reaching out in all directions, the hydra instantly paralyzes any minute insects, young snails, or infusoria that touch its feelers."[37] The paralysis is due to a poisonous substance concealed in certain cells. From the simplest form of this class to the large jelly-fish, as well as the coral, each organism has a specialized mechanism to aid in the struggle for life. Its adjustments and coördinations

[36] Couch, "Illustrations of Instinct."
[37] Gentry, "Life and Immortality."

seem to be as unvarying in principle as are the instincts of birds.

Lower down in the scale we find the monera, mere specks of living matter, devoid of nerves. They put out feet which are momentarily withdrawn, and slender threads to grasp their food. They flow around the latter rather than seize it. Endowed with no digestive apparatus, they thus appropriate nutriment, and when they have become mature, multiply by fission. Each division is then a living moner. There is no death, no corpse, and individual immortality is realized. There is, in this low form of life, an elementary habit and motor adjustment which has been considered organic memory. Binet holds that the appropriation of food in itself constitutes memory. By others it is regarded as chemotropism. Yet these physiological movements may contain psychic elements.[38] Hering, of course, holds that organic memory characterizes this and all other living matter. J. Arthur Thompson attributes memory to all protozoa. We now reach the border line between the animal and the vegetable. The word *kingdom* might be added, but the two forms of life shade off into each other by inseparable degrees, and in many cases the protozoa cannot be distinguished from the protophytes. The former have no digestive cavity or nervous system, while many of the latter are endowed

[38] J. Irwin France.

with power of locomotion. In both forms we find the same structural habit which has already been emphasized. An amœba when excited by electricity [39] manifests a typical contraction at the anode, and an expansion at the kathode. Bacteria, infusoria, and "all free living forms" respond to chemical excitation by turning towards or away from the excitation. Moreover, these low forms of life, when affected by different forms of pressure, as by a slow stream of gently flowing water, respond in a definite and fixed manner. Infusoria and bacteria manifest a geocentric property and turn towards the centre of the earth. Such forms give a definite response to heat also, and are influenced by fatigue, for an excessive intensity of excitation or a lesser intensity continued for too long a duration results in laming or in a paralysis of the organism.[40] These examples indicate a definite structural adaptation similar to that already found in the higher types nor need we stop with these primitive living forms, for plant roots grow towards the centre of the earth and are positively geotaxic, while their stalks, being negatively geotaxic, manifest just as certain a tendency to grow away from the earth centre.[41] Charles Darwin speaks of the bean radicle as "distinguishing harder from softer substances," and

[39] "Allgemeine Physiologie, ein Grundriss der Lehre vom Leben," by Max Verworn.

[40] *Ibid.* [41] *Ibid.*

states that the waving or swaying motion of plants is begun by the young plant before it is out of the ground. The neural mechanism of animals is not more responsive to touch than are the cassia, sorrel, sensitive brier, and the sensitive plants, whose leaves close at the slightest touch. The bacteria do not respond more definitely to electricity, chemical excitation, or to pressure than do plants to the influence of light. So strong is this power that plants situated in a room must be turned frequently in order that they may grow symmetrically. Certain plants are so phototaxic that when located in the garden in the bright sunlight they follow the sun's course during the whole day, and the blossoms turn in the opposite direction at evening from that which they had in the morning. Moreover, the very cells from which the plant-roots are developed recede from the light, while those cells from which the parts above the earth are developed turn towards the light. No congenital movements of animals are more definite than the tendency of the hop-vine to turn in one direction and that of the bean in the opposite, for in each instance motor adjustments of the organism have formed a habit. The filaments of certain carnivorous plants, like the Venus's fly-trap, are almost as sensitive to touch as are the antennæ of animals, for at the slightest touch the lobes close and the plant-robber has his prey. The sundew (*Drosera*) emits a drop of acid fluid which at-

tracts and imprisons the insect, and then the leaf curls up as if it had tentacles, and the food is secured. In each case the insect was a victim to structural habit and excellent motor adjustments. Examples need not be multiplied. Definitely coördinated movements in both animal and plant organisms seem to be transmitted in some manner from generation to generation. What is at first a tendency, adjustment, or response to an excitation develops into an habitual reaction. If the reader will now turn to Professor James's chapter upon Memory and note the emphasis which he lays upon habit in his discussions of this subject, he will, perhaps, in the light of the array of facts which we have given (by no means as extended as it could have been made), be able to realize what Hering, Haeckel, Ribot, and others mean when they speak of such an organic adaptation as a racial memory. The question now to be considered is, Are we justified in applying the term memory to such organic conservation? Does the array of facts here cited regarding instinct enable us to select certain common elements which may be termed Memory or Memories? What elements belong alike to inherited impulses manifested in such manifold ways as the following: the inherited instincts of man, such as fears and taste; the dying instinct of the huanacoes and horses; the excitement caused by bright colours; the instinct of wolves, jackals, and hyenas to hunt in packs and to pre-

pare their beds as their ancestors did upon the plains; the instinct to kill manifested by feral dogs, ferrets, and weasels; the toilet of animals; the robbing instinct of the cuckoo, and that of other birds to feed it; the habit of birds to migrate at certain seasons and in a definite direction; the occasional migrations of the lemming, field-mice, grasshoppers, and butterflies; the nest-building instincts of birds and fishes; the skill of the spider manifested in spinning its web; the passive defence of insects due to assumed shape, posture, buzzing, and to certain false and misleading movements? Is there a factor common to all of these activities? While we cannot understand all that instinct is, it is safe to affirm that in these unconscious processes there is a congenital adaptation to definitely coördinated movements, or to the inhibition of movements which the young possess without teaching and which is not derived from the experience of the individual. It is a racial experience conserved and handed down from generation to generation. It appears, moreover, that such adaptation can be traced to the simplest forms of organic life, both animal and plant. It is these definitely coördinated activities, varying little in parent and offspring, which Hering calls memory and believes to be a property of all living matter. To quote from our discussion upon Hering in Chapter I, "It [the cell] repeats what it feebly experienced as part of a greater whole, as an

old man repeats the experience of childhood. Thus memory is a continuous process, and the whole series of organic life is a reproductive faculty of what belonged to the first organic forms. The ability of the spider to spin its web was acquired by innumerable generations of spiders." This theory, partly because it is in harmony with many of the facts under consideration and partly by its boldness, has made a deep and perhaps lasting impression. An apparent objection to it has been raised in Weismann's hypothesis that acquired characteristics are not inherited. Weismann's theory changes so often that it is difficult to state it in a satisfactory manner, but at present it may be summed up as follows: Nerve-cells are of two kinds—somatic (bodily) and germ cells. The nucleus of the latter contains germ plasm. Another name for this plasm is "id." An id is composed of determinants, and each determinant may be divided into biophores. A biophore is composed of chemical molecules. A number of ids form an idant, which is either a chromosome or a chromatin fibre. The germ plasm is unstable, but the degree of its instability is restricted within the narrowest possible limits. Each change in body or mind is represented by a particular change in the plasm. He formerly held that it cannot be affected by acquired characters, nor change during the lifetime of the parent. Modifications of the parent during life are not transferred to the germ substance, but such

changes in body or mind as occur are represented, in the course of time, by a particular change in the plasm. The strongest biophores survive and the weak ones die. The child possesses inherited traits because it is an offspring of the same branch as its parent. The inheritance was not due to a change caused by the environment of the parent. As already intimated, the advance of histology has necessitated radical changes in the theory. Weismann first stated that the entire germ cell contains the germ plasm. Then he was forced to conclude that only the nucleus, and later that a part of the nucleus, has this function. The stability of the germ plasm was at first maintained, but he has been forced to conclude that it is universally unstable. Yet by reducing this instability to a minimum he has saved his theory in a modified form. His later teachings seem to show that the hereditary variation is due to the influence of the environment upon the biophores. It is difficult to determine whether the theory is losing ground. Certainly metaphysical discussions are making little headway toward solving the problem. The only solution apparently lies in the inductive method, but indisputable facts are difficult to obtain. What is pertinent to the present discussion is whether the congenital modification be due to germinal selection. It may be quite probable that these modifications occur more slowly than we have been led to believe. It matters little,

however, whether the power of selection resides in the determinants furnished by the individual or in the influence of the environment upon him in some other way. The variations certainly occur, and they may be retained. The difference is in part a war of words. Weismann approached the subject through the microscope; Spencer, Darwin, and others, through the large telescope of English common sense.

As noted in the last chapter, Ribot fully indorses Hering's theory, and Draper, as we have seen, dwells at length upon the power of the ganglion cells to retain impressions. Romanes, speaking of the ability of the ganglion cells to remember, writes: "When a powerful galvanic current passes through a bundle of muscular fibres they are less excitable than before to a current in the same direction, but more excitable than before to a current in the opposite direction." Habit, he says, is the substance of both the ganglionic and psychological memories. Again he writes: "In all but in the absence of mental constituent the nerve-centre concerned remembers the previous occurrences of its own discharges. These discharges have left behind them an impress upon the structure of the ganglion, just the same in kind as that which, when it has taken place in the structure of the cerebral hemispheres, we recognize on its obverse side as the impress of memory." He adds, by disuse a ganglion may forget its previous

activity. In such a case " The particular activity forgotten by the ganglion may be more easily reacquired than originally it was acquired, which is just what we find to be the case with mental attainments." [42] Cope, when advocating the theory that molecular motion may be transmitted, writes: [43] " It [energy moulded by the interaction of a living being, and its environment] is the recorded expression of the habitual movements of the organism which have become impressed on and recorded in the reproductive elements. It is evident that these and the other organic units of which the organism is composed possess a *memory structure*. . . . This memory has perhaps the same organic basis as the conscious memory, but for reasons unknown to us consciousness does not preside over its activities." Delage writes in *Hérédité:* " Life is reproduction, and reproduction is nothing else than memory. It is unconscious in the plastidules, but it exists, while the simpler chemical molecules, as atoms, are deprived of memory and, as a result, of the faculty of reproduction." With these biologists Haeckel and Spencer agree. Haeckel called the hereditary somatic variation caused by remote impressions upon the cells and the egg, unconscious memory. He writes: " The plastidules are distinguished, however, from all other molecules by the ability

[42] " Mental Evolution of Animals," pp. 35, 36.

[43] E. D. Cope, " Primary Factors in Organic Evolution."

of reproduction or memory." "One can denote the hereditary quality as a memory of the plastidules." [44] Herbert Spencer, in his chapter on Memory, writes: "Instinct may be regarded as a kind of memory. On the other hand, memory may be regarded as a kind of incipient instinct. The automatic actions of the bee . . . are, as it were, organically remembered." Perhaps this sketch sufficiently represents the view of memory advocated by Hering, Haeckel, Spencer, Cope, Ribot, Delage, and which is found in much current literature. Whether we indorse the hypothesis or not, it is apparently supported by many facts. The physical conditions are presumably the same in both memory and organic memory. In each repetition and habit play the chief rôle. Consciousness alone is wanting in the organic memory; but its presence or absence constitutes a wide difference, not so wide, however, as to preclude a careful study of organic conservation as a theory of retention. Moreover, since Hering wrote, the terms "organic memory" and "atavistic memories" are frequently met. Perhaps the chief objection is not to the theory as such, but, as already stated, to the use of the term "memory" for the purpose of designating the congenital retention. Yet the employment of the expression "organic memory" or its equivalent by authors like those cited above, as well

[44] See "Natürliche Schöpfungsgeschichte," vol. i., chap. ii., pp. 200, 201.

as further discussions in the remaining chapters of this book, make it clear that the word memory has acquired a wider significance than that which it formerly possessed. Nor is there the slightest reason why the content and use of this word should not change as psychology advances. The fact is the term has taken on a new significance, and the use of the plural form—memories—has taken root too deeply to be eradicated. The facts cited in this chapter regarding both conscious and unconscious conservation of experience and all that follows upon brain localization alike render it imperative to speak of the organic memory or memories, and of conscious memories. So far as the singular form of the term is employed we shall only use it as a matter of convenience.

The view of memory which we have now obtained is almost too wide to admit of or to need a definition. The discussion of this chapter, however, may be summed up in the following statements: Organic memories refer to the ability to conserve racial or individual experiences by modifications of the organism.

Conscious memories consist of the ability to fixate, to retain, and to reproduce past impressions with the consciousness that they previously have been experienced.

CHAPTER III

DISEASES OF THE MEMORY

O strengthen me, enlighten me;
I faint in this obscurity,
Thou dewy dawn of Memory.

TENNYSON: *Ode to Memory.*

WHEN certain mental functions are eliminated by disease the remaining ability or abilities stand out separate and afford a rich field for study. In order that the reader may be better prepared to determine the real nature of memory, a study has been made of a large number of minds which were affected by disease or suffering from an injury caused by accident. Most of the cases cited have been studied personally, although some material was furnished by alienists who are first of all psychologists. The method employed in obtaining the records was as follows: At the hospital visited, the physician who was most interested in the psychological aspect of disease designated the patient to be studied. A copy was made of the history of each case, and the records were carefully investigated. Finally the patient was visited as many times as was deemed necessary, and carefully questioned, for

the purpose of ascertaining his memories and noting the defects. A few patients whose mentality was nearly gone were studied a number of weeks. Tests were made of the different senses. If the mental suffering was due to accident (traumatism), the patient was questioned in regard to experiences before the injury to ascertain the absence or comparative absence of memory prior to the date of onset or injury (retrograde amnesia); in like manner the absence or comparative absence of memory subsequent to the date of mental injury (anterograde amnesia) was considered. Extensive notes were thus taken, which formed the basis of the following discussion. Amnesia, or loss of memory, may be considered sensory or motor in nature; in general the former refers more exclusively to a mental state, the latter to a physical condition. Both forms of amnesia are illustrated in aphasia.[1] The vocabulary of an aged man consists of about forty words. When asked, "What city is this?" he gives no reply, but looks interested; when a wrong name is suggested he shakes his head, without uttering a word. At the mention of the right name he answers, "You're right." The sensory image of the name, though weak, is sufficient to enable him to recognize the correct name when he hears it.

[1] Aphasia (α, privative, and φάναι, to speak) literally signifies inability to speak. Patients who can utter but few words are called aphasic.

He is able to write, and cherishes a fairly complete memory of his early home and school. The motor memory is lacking, which is probably due to the fact that the nerves connecting the brain-centre for motor images and the speech-centre are diseased. Or it may be there is a lesion in the motor path. The power of expression is wanting. A characteristic of this form of aphasia (Broca) is that the man swears very fluently.[2] These profane words, of course, were acquired and used in times of mental excitement, and the association between the excited conditions in which they were employed and the similar conditions in which they are now uttered may account for a part of this facility. This record will help us to distinguish motor from sensory memories when we reach Chapter V. A more complete aphasic condition was found in the case of a man whose mind evidently was affected by poisons arising from the organism (auto-intoxication). He could utter the word "Yes," and once in a while would say "No"; could count one and two, but no further. He can mentally represent neither letters nor syllables, and, what is very rare, is verbally blind for figures also. He is unable to write voluntarily. Where so many complications exist it is impossible to designate the exact form of

[2] Ribot, Hughlings Jackson, and Broca note that aphasic patients readily indulge in profanity.

aphasia. While the Broca convolution may be affected, the case would seem to illustrate sensorial and possibly ataxic aphasia.[3]

Most normal persons at times employ a word other than that which they intend to use. Such cases of paraphasia are often found in mental disease. A common key may suggest a book, or some other word not the correct one is employed. Sometimes the function of the object is used to designate the object, and the key is called "Something to open the door with." Another patient, studied for some time, illustrated both sensorial and ataxic aphasia. He was agraphic, being unable to write anything but his own name. He employed only two expressions: "All right" and "You must take the pills as they come." The ability to use this

[3] "Sensorial aphasia (Wernicke), in which there is loss of understanding of spoken and written language, inability to repeat words, to write to dictation, and to read aloud. The patient can write or copy words. Volitional speech is imperfect, and paraphasia (inability to connect rightly the ideas with the proper words) may exist. The lesion is at the centre for auditory images.

"Under sensorial aphasia are comprised: (*a*) Word-deafness, which is inability to understand spoken language; (*b*) Word-blindness, which is inability to understand written words.

"Ataxic aphasia (Kussmaul), in which there is loss of volitional speech, repetition of words, reading aloud, volitional writing, and writing to dictation. The patient, however, is able to understand spoken language and possesses the faculty of copying. The lesion is at the centre for motor images." (Landois and Stirling, cited by Hyslop.)

sentence was lost shortly before his death, which occurred a year subsequent to my study. We learn from this man's mind that time orientation, in which many people are deficient, may remain as a very permanent acquisition, for he could localize experiences in time for a period of four years after most mental power had disappeared. He illustrated how deep-rooted a jocose expression may become, for it is fair to suppose that the sentence which he uttered was used in his previous healthy condition and meant " You must take the good and evil as they come." He also showed how permanent an acquisition is one's own name, which he could write, and it is said that no patient has been found so agraphic as to be unable to write his own name. Lastly, while little ability to judge was left, he could distinguish money of different denominations. This acquisition, made during a long business career, remained to the last. Another business man who had been a member of the stock exchange could recall his business experiences as well as a prize received for memorizing Hamlet, although other memories had been swept away by the ravages of disease. We see, then, that aphasia may assume one of several distinct forms, or that two or more forms may exist together. As Mirallié puts it: (*a*) one may have the notion of the idea and not that of the word with which to express it; (*b*) he may have the notion of the word and not the notion of the

idea which corresponds to the same; (*c*) he may be able to form both notions but be unable to pass from the notion of the idea to that of the word. This characterization, he says, is the gist of the different kinds of aphasia. Such cases studied anatomically show that the aphasic form differs with the locality of the lesion. If the lesion be in the centre for auditory images, we have sensorial aphasia, which may assume the form of word-deafness or word-blindness. Commissural aphasia (Wernicke) is subcortical, resulting perhaps from lesions in the commissural fibres. The patient can repeat words, write to dictation, and read aloud. Otherwise it resembles Broca's aphasia. If the motor centre be affected, ataxic aphasia (Kussmaul) may result. Lesions between the auditory centre and the perception centre also render the patient unable to comprehend the spoken or written word. It seems to be established that if the auditory area be destroyed by disease, the patient cannot employ language and so loses all understanding. Analogous amnesic conditions are alexia, or inability to read, and amusia—inability to understand or to express music. Both conditions were realized in the case of the second patient referred to above. Whatever form aphasia may assume, it must be regarded as a species of forgetfulness. If it be sensorial, the memory loss approaches more nearly to the psychical form. In other instances it comes nearer to

being a physical inhibition. This study leads us to attach some degree of importance to the organic memory and indicates a close relation existing between the physical and the psychical.

All people are subject to illusions,[4] which if not corrected remain in the mind as permanently false memories. As we should expect, such experiences are emphasized in pathological conditions. We know that a stick or an oar half immersed in water appears to be bent. As Mach has observed, in the accompanying figure *b* may appear nearer or farther away as one imagines. Sometimes when a clock strikes we experience an illusion of an additional stroke after the striking has ceased. Frequently upon leaving a car or steamer we feel the sensation of motion continued. Certain retinal processes may make an object appear double (James). The latter are passive illusions, while the first two illusions may be classed as active. Hyslop, in addition to such examples as are already given, mentions among passive

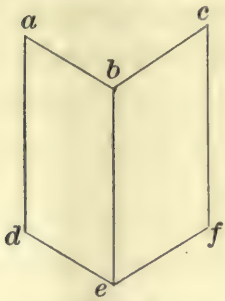

FIG. 1.

[4] An illusion is an inadequate perception arising from an external stimulus. The term is applied to the mistaken interpretation of one object or experience for another. An hallucination is a false perception which has no appreciable external stimulus. A delusion is a false belief. Paranoia is a mental disorder in which delusions are elaborated as abnormally prominent concepts, or as hallucinations.

illusions the perception of light (phosphemes) when the eyeball is pressed, and the fact that we refer sensation to the peripheral ends of the nerves. Illusions of ghosts are mostly due to a wrong interpretation of a presentation, and any white object becomes a spirit. Mental preperception so potent in attention seems to play a large rôle in active illusions. An audience, half wishing to be deceived, may involuntarily adjust itself to the manipulations of the prestidigitator. There are also illusions arising from related presentations of other senses. "Some individuals never have a presentation of a certain sense without the occurrence of a presentation of another sense, e.g., coloured sounds, sensations of colour from perceptions of taste, smell, pain, temperature, and touch." [5] Illusions of memory are analyzed by Kraepelin as follows: (1) Simple paramnesia (Erinnerungsfälschung sprechen). This is common in hallucination in which the recollection is imaginary with no basis of experience. It commonly occurs in paralysis, and Kraepelin gives as an example those who have great ideas (megalomania). (2) Associating paramnesia (associirenden Erinnerungsfälschung). Here an actual impression suggests an illusion of memory. (3) Identifying paramnesia (identificirenden Erinnerungsfälschung), in which "The entire represented situation, in all

[5] Hyslop.

details, appears as a simple photographic image of an earlier experience." His analysis does not differ essentially from Sully's divisions of paramnesia, which are as follows: (1) false recollections to which there correspond no events of personal history; (2) those which misrepresent the manner of happening of the events; (3) those which falsify the date of the events remembered, for " When I distinctly recall an event, I am immediately sure of three things: (1) that something did really happen to me; (2) that it happened in the way I now think; (3) that it happened when it appears to have happened." The following law announced by Sully is important: When we have to do with the infrequent, the unimportant, and therefore the unattended to and exceptional, we employ the ordinary, the familiar, and the well-known as our standard. " In a word, illusion in these cases always arises through what may figuratively, at least, be described as the application of a rule, valid for the majority of cases, to the exceptional case." Now, it is evident that all illusions of vision will be retained in memory as illusions. The memory will be of the same nature as the perception. He who perceives the days of the week in coloured terms will remember them in coloured terms. The child's imagination is so strong that it is often accused of lying when an illusory memory has assumed all the reality of actual experience. The habitual liar blends illu-

sion with facts until he has the proverbial liar's memory.

Before entering upon the interpretation of paramnesia in cases of paranoia it is necessary to realize that while such experiences are more pronounced, they find their analogies in every-day life. Indeed, a perfectly normal mind, if the organism be fatigued, may easily misinterpret at night an auditory presentation, and the auditory illusion modifies the subsequent visual perception. If this be true, it is easy to see that in paranoia both visual and auditory illusions become emphasized and assume all the " warmth and intimacy " of actual experiences. A patient saw " a cannon-ball let down through the room," and was positive that it was not a dream. " It went back because it was ordered to return." " It was in the daytime," but may have been in 1895, 1896, or 1897. The defective time orientation shows that the experience was not in all particulars sharply defined, but the main feature was so vivid as to mislead an intellect for the most part intelligent and penetrating. Kraepelin's second division is illustrated in the many forms of homicidal paranoia in which the patient suffers most of the agonies of death. Another interesting form of this illusion is that of seeing faces. The features may be old or young, composed or distorted, the face of a man, a woman, a child, or rows of faces, according to the whim. One such patient apparently inter-

preted as a face two brown spots upon the wall about as far apart as the human eyes. At first he hesitated to say that he saw other faces; but without suggestion the face psychosis began to work and rows of faces became apparent. Such experiences become incorporated to a greater or less extent into permanent experience and become illusions of memory. That the illusions of hearing should give rise to false memories is not strange, for the auditory impressions are more difficult to interpret than are those of sight and touch, which difficulty may be due to one or more of a series of causes. Hyslop assumes as causes of auditory illusions: (1) a modification of external stimuli by the mental complexion; (2) the physical auditory apparatus may distort the stimulus; (3) entotical (pertaining to the interior of the ear) conditions may determine ingoing currents, or they may be perceived as illusory; (4) stimulation of the auditory centre itself may give rise to the hallucination; (5) hallucination may occur in deaf people; (6) the mind itself may become so satisfied with an auditory idea that it preperceives the looked-for stimulus; (7) hallucinations of hearing may be unilateral.[6] It is useless to tell the subject that the experience is imaginary, for if the receiving apparatus or auditory centre be diseased he will experience an actual sound. The following case,

[6] "Mental Physiology," p. 273.

which for convenience is designated as No. I, serves well for illustration: The patient, age 44, has suffered for two years from homicidal paranoia, having pronounced visions of persecution. She hears persons threatening her, but never sees them. Her hallucinations are usually auditory. She hears "voices talking over the wires at night." Before entering the hospital, while passing a jewelry store, she heard the voice of a man offering her a bracelet. She turned in anger upon the first man whom she met, to avenge herself. Such an experience she recalls as an actual memory, quite as real as are the meals which she ate to-day. Yet her memory of her past life is good. She knows well the beautiful town where her home is, and justly takes pride in her family, which was celebrated in the American Revolution. She recalls where she lived at the age of four, and remembers a marked experience at five. Possibly she recalls her father's death and funeral at the age of two and one-half, but it is not quite certain that the family did not subsequently describe it to her. Yet her real and illusory images are the same in point of vividness and certainty. Nothing could be sadder than this slowly progressive disease making its inroads on the mind of a talented and cultivated person who still cherishes perfect memories of her beautiful childhood and youth. Her case illustrates Kraepe-

lin's first division. It is to be noted that her true memories are chiefly or wholly of a visual type, while her false memories are auditory. This case enables us to see how distinctly in mental disease one phase of memory, or, better, one memory, may be thrown into relief so that it can be studied easily and intelligently. In other instances in which visual illusions predominate auditory paramnesia is present and emphasizes the former. Kraepelin's second division is illustrated in a great variety of forms. The mental rhythm of elation and depression naturally receives emphasis in pathological experiences. Illusions of wealth and power give rise to false memories. Convinced that he is the Christ, the patient recalls as a real experience having created the world. In case of recovery, a test as to the validity of an experience is the ability to localize the same in time and space. This study enables us to realize the force of the popular belief that fatigue and sickness exert a potent influence upon the memory of normal minds, for under such conditions the illusions of perception are emphasized.

Kraepelin's third division is illustrated by double vision, or what the French term *déjà vue.* Many patients when first brought to the hospital state that they have been there before. No illustration need be given, for the experience is one which they share with normal persons.

"I have been here before,
But when or how I cannot tell;
I know the grass beyond the door,
The sweet, keen smell,
The sighing sound, the lights along the shore.
You have been mine before,
How long ago I may not know;
But just when, at that swallow's soar,
Your neck turned so,
Some veil did fall—I knew it all of yore." [7]

Some people who visit Europe for the first time experience a feeling of familiarity upon entering strange cities. When travelling the mind is thoroughly awake and memory activity is excited. Most cities as well as woodland scenes have certain common elements. Often we have read of distant cities and scenes and have temporarily forgotten the facts. Under the stimuli of novelty and travel these images are awakened and a disproportionate value is assigned them. At the age of 12½ Mr. P., while upon a high hill 18 miles from his home, expected to see the cars for the first time. Upon seeing a coal train he was impressed that he had seen it before. The train, the direction in which it was going, and the entire place seemed familiar. Upon relating his experience at home he was told that he had been taken to the same hill at the age of 3½ and had then seen a train moving in the same direction. If, instead of having seen the cars there, he had merely read of them or had heard them

[7] Rossetti's "House of Life," cited by H. T. Osborn.

and the locality described, his experience would have passed for double vision. There are, however, instances in which a new experience seems to be identical with a past one. Kraepelin believes that the illusion is largely the work of the imagination. Sully states that our dreams are to a large extent answerable for the experience, and adds: "Is it not almost a romantic idea that just as our waking life images itself in our dreams, so our dream life may send back some of its shadowy phantoms into our prosaic everyday world, touching this with something of its own weird beauty?"

Wigan, who was one of the first to offer an explanation, assumed that one-half of the brain functions first, and that the interval between the action of the halves, though brief, leads to a confused judgment. Anjel supposes that in such perceptions processes of sensation and perception which usually overlap become separated. Jessen and others make it due to a fatigued condition of the mind, in which a fading sensation cannot be distinguished from a represented impression.[8]

Ribot and Fouillée adopt the hypothesis of two successive images. Ribot holds that the first image is real while the second is hallucinatory. According to Bernhard-Leroy[9] race, sex, and social conditions have no influence, but the

[8] Cited by Professor Burnham.

[9] "L'Illusion de Fausse Reconnaissance."

experience characterizes youth more often than adults. It lasts but a few seconds. He finds that intoxication exerts no influence, but that fatigue favors the condition. His own explanation, made after a careful study, is that the phenomenon is due to a logical deduction. In cases of true recognition, he says, after the image or group of images has been recognized there are called forth one or more images associated with it in the original perception and which constitute the difference between the old and the new experience; then by considering the idea successively in different settings we get in some way the new thought. He seems to imply that in this logical operation a wrong deduction may be made which is the basis of the false recognition.[10] To conclude: Fatigue of the organism, particularly at the adolescent period, constitutes a favorable condition for double vision. Dreams and half-forgotten statements heard and read may exert an influence. But the simple explanation of a false deduction and wrong interpretation—due largely perhaps to the predisposing conditions just named—seems upon the whole to be the best.

Other phases of hypermnesia deserve at least a passing reference. Sir William Hamilton in his Lectures writes: "The second degree of latency exists when the mind contains systems

[10] "L'Illusion de Fausse Reconnaissance," pp. 95, 96.

of knowledge or certain habits of action which it is wholly unconscious of possessing in its ordinary state, but which are revealed to consciousness in certain extraordinary exaltations of its powers. The evidence on this point shows that the mind frequently contains whole systems of knowledge which, though in our normal state they have faded into absolute oblivion, may in certain abnormal states . . . flash out into luminous consciousness and even throw into the shade of unconsciousness those by which they had for a long period been eclipsed or extinguished." Mr. G., 83 years of age, informs me that eighteen years ago his arm was caught in a shaft and that he immediately sustained almost fatal injuries. "My whole life passed before me. I did not remember it. I saw it as if painted on a cyclorama." A hyperexcitability exists in the hypnotic sleep. Richet [11] writes: "After hypnotizing V., I recited some verses to her and then awaked her. She was unable to remember them. I hypnotized her again and she remembered the lines perfectly. When we awaked her she had again forgotten them." Charcot[11] found that a hypnotized subject recalled the name of a physician whom she had not seen since she was two years old, although in her waking states she scarcely recognized his features. The excitement of hypnosis, fevers, accidents, etc., arouses

[11] Cited by Binet and Féré in "Animal Magnetism."

cerebral centres and awakens emotions and trains of associations long dormant, so that it is difficult to say when we have entirely lost an experience.

A critical examination of the contents of both pathological and normal minds leaves little doubt that memories, both rational and irrational, are modified by dreams. "If a dream serves to connect a certain idea with a place or person and subsequent experience does not tend to correct this, we may keep the belief that we have actually witnessed the event, and we may naturally expect that this result will occur most frequently in the case of those who habitually dream vividly, as young children."[12] It is well known that in old age many people cannot easily distinguish between actual experiences and dreams. Sir Henry Holland[13] explains this from the fact that in old age life approaches to the state of a dream. An author's characters may have a real existence, so far as the writer is concerned, and upon the completion of the work he may find that he has formed a personal attachment for them.

Akin to dreams is the experience of the somnambulist. As is well known, he does not recall in the primary state what transpired in the secondary state and *vice versa*. A young man who

[12] Sully.
[13] Cited by Sully.

suffered severe headache owing to fatigue induced by long bicycle rides became an habitual somnambulist. He would ride his wheel at night and find himself in dangerous positions, as upon the edge of a precipice or up in a tree. Upon awaking he never recalled what had transpired during one of these states.[14] Frequently the somnambulist acts out a dream. B., age 18, in a somnambulistic state, came down-stairs and in the presence of witnesses hid his hat and coat under the lounge. The next morning, upon asking where they were, he was told that he would find them just where he had put them. After thinking a few minutes he went directly to the place where he had concealed them the night before. He then stated that he had dreamed that a young man in the neighborhood was coming for the hat and coat, and that he must hide them. As a dream may lead us to cherish a false memory as a true experience, so, by means of association, it may aid the memory to recall another dream or an actual experience.

In most cases of diseased memories the introspective habit is a very constant factor to be considered. The patient is self-conscious and self-centred. The state of mind renders possible and colours the prominent concepts in paranoia. In normal life this tendency is illustrated

[14] Reported in conversation by Spencer B. Kinney, M.D., Middletown, N. Y.

by what Dr. Savage has happily termed the "lost-button psychosis."[15] The absence of a coat-button leads a person to imagine that all people have their eyes centred upon the defective place. This can only be believed because the individual has his own attention centred upon the loss. This absorption, in itself, prevents the subject from receiving new presentations, and therefore new sense memories. The old notions are worked over and over, and the prominent concepts dominate the whole field of association. Thus a few notions colour and determine the memory tone as a prism transmutes the clear sunlight into a few brilliant colours. For this reason a single memory or a series of early memories may remain very clear because the whole psychical activity is centred upon them. A dement whose real experiences are blended with illusions will recall accurately the early instruction of parent and school. Indeed in one such case the intellectual memories predominated over the emotional. Again, a coloured imbecile manifested an alternating rhythm of attention which sharply defined his primary from his secondary stage, amounting to little less than an alternating personality. In the *secondary* state he was stupid and showed little memory or reasoning power. In the primary state he would answer the calendar for years, i.e., when

[15] Cited by Hyslop.

given one's birthday, naming the year, month, and day of the month, he would tell at once what day of the week it was. This remarkable faculty regarding the calendar is all the mental power which he manifested in the primary state, and he must be classed as an idiot savant. How completely a condition of toxication or auto-intoxication can remove the vestiges of memory can only be realized by a study under favourable conditions. I have met one person who manifested no memory, even the most deeply embedded motor memories, as the winking reflexes were wanting; but more instructive are those cases in which there are slight recollections of past experiences that may be traced by painstaking study. The following is such an instance. While the memory was nearly gone, what remained afforded a rich field of investigation. We will designate the patient as No. II. She was born in Ireland in 1847. Her habits were temperate and industrious. Climacteric influences were the assigned cause of her illness. When admitted to the hospital in February, 1897, she reiterated that she had only one child. She lacked intelligence and had much mental confusion. Her language was incoherent. It was found that for two years she had experienced a gradual loss of mind. In 1893 she lost a daughter over whose death she brooded much. Gradually she became unable to talk and would often use one word for another. At the time of her

admission she recollected events of long ago, but her memory for recent events was poor. Q. "How old are you?" A. "Twenty-four." Q. "What is your husband's name?" She answered correctly and stated her own name correctly. She would read slowly, as if spelling the words. She copied imperfectly from a book and from writing. When shown some flowers and a picture of a cow, she said, "The flowers look like a horse, and the cow looks like a priest." Tests of taste and smell showed that these senses were very imperfect. The diagnosis was "Organic dementia, with partial aphasia, alexia, agraphia, partial paraphasia, and no insight into errors." Tests made at different times in the month of October, 1897, showed that the field of mental vision had narrowed very much since her entrance to the hospital, and that in almost every region of the intellect the disease was progressive. A few sentences almost meaningless, if not quite devoid of content, constituted her conversation and ran something as follows: "It is 54, yes, 54 years. They are over there just 54 years." When shown a ring, she said, "It is a nice little one," and called almost every object a ring. She called a lead-pencil "nice," and in reply to all questions answered, "It is 54 years." A prolonged and careful questioning at different times about her early home suggested at length a distant association. She said, "Mrs. O'Brien, she was nice." After this she frequently said, "Mrs.

O'Brien, she opened the door and it's 54 years." She was taken to the window and shown a pile of brick and some men at work beyond the brick. Amid her mutterings she looked at one of the men and said, " Man." At another time she was led to a different window where she could see a young man, perhaps 18 years old, at work, and she said, " Boy." Tests of the sense of touch showed partial anæsthesia. Her hands were placed, one at a time, upon a steam-radiator which was unpleasantly warm; she said, " It is nice." At length when she withdrew her hands, upon being asked whether the radiator was hot or cold, she answered repeatedly that it was cold. Upon feeling a knife she volunteered the remark that it was cold. When I saw her three days later she smiled and said in substance, " I have seen you before," but at other times showed no signs of recognition. When asked to take off her ring she took it off and called it a " pretty ring," yet she persisted in calling pencils and pens rings. Her attention was engaged, and an assistant blew a very shrill note upon a fife close to her ear. She paid no attention to this, nor did she heed a tune that was played; but when the fife touched her ear she turned her head and apparently listened. When it was played in front of her she noticed it and manifested signs of pleasure. Her sense of taste is much impaired, but she shows some discrimination. She relishes sugar, and when asked whether it is sweet or bit-

ter says that it is sweet. After taking five grains of quinine she says, " It is sweet and nice," but her face expresses an entire absence of interest or a look of disapproval, and the tone in which she says the quinine is sweet is that of the guest who compliments the biscuits of her hostess when they are not very light. She has no sense of smell, and enjoys the odour of pyridine as much as that of a carnation pink. Letters and words mean nothing to her. She can distinguish the picture of a man from that of a woman. When shown the picture of a man, she says, " Man." When shown the picture of two men, she says, " Two men." She can distinguish horses from cows in a picture. With " cow " she associated the word " coward," and with the latter "man." We find, then, a slight sense of taste, while that of smell seems to have wholly disappeared. The auditory sense is more inhibited than the tactile, yet neither is so good as the visual. We note, also, that the memories are nearly all visual, or are suggested by visual association, i.e., they are of the same nature *as the prevailing sense.* This harmonizes with our hypothesis developed in Chapter VI regarding the nature of the memory. In the second place, we find that the concepts or reactions which abide are abstract rather than concrete, e.g., man, boy, cow, numbers. Again, while she can count so high as two only, she recalled the number 54, which is frequently used. The association which

Ebbinghaus found existing between numbers separated from one another cannot explain this, for the gap between 2 and 54 is too wide. The explanation must be sought rather in the power of attention, which enabled her to retain clearly an insistent idea. Finally, the memory is better preserved than the other mental abilities. The latter have almost entirely disappeared, although in calling the warm radiator and the knife cold there may have been a weak effort to judge. Perhaps the erring judgment in regard to the radiator suggests paraphasia. It would be interesting to find what an anatomical study later will show. Have the convolution of Broca, the tactile centres, and the auditory area sustained something like a proportionate loss, while the optical areas still remain better preserved? Certain anatomical investigations, such as Donaldson's study of the brain of Laura Bridgman, may suggest this without claiming to furnish a complete explanation.

When toxic influences due to alcohol lead to derangement of all mental functions, we find a favorable condition for mnemonic study. One patient, whose difficulty arose from an excessive use of alcohol and sorrow for his wife's death, realized that his memory had entirely disappeared. But as he recovered slightly he seemed to appreciate the gain. The mental confusion was attended by lack of orientation in time and space. As his mind cleared up a little, the ori-

entation did not improve in a corresponding degree, but rather diminished. The children's names, for the most part, remained; but he was not sure how many he had, nor could he name them all in the order of age. He recalled his wife's name and a statement which she had made to the effect that if she died he would not know the names of the children because he cared for them so little. He remembered his wife's excellent qualities. Another definite memory was that he did not lose a day the last year he worked. He also recalled the name of the street upon which his brother lived. He did not remember the day of the week, but concluded that it was not Sunday, as he heard the carpenters at work. The latter statement implies a certain ability to make an inference, but this power was not so good as his memory. In general, memory is the power which in disease is best preserved, but perhaps no one mental ability entirely disappears while the others remain intact. Notwithstanding the fact that he cared for his children so little when in health, his remembrance of their names was better than his memory in other directions. The topographical memory was preserved in some degree. Certain emotions seem to have aided his memory, for a sense of pride was manifested in the recollection that he had worked steadily during the last year, and affection may have aided his memory for wife and children. Aside from the ability to recall proper names, localities,

and experiences dependent upon strong emotion, he possessed slight power of recollection.

If we turn our attention to amnesia due to traumatism, we find that an accidental blow upon the head or an injury to the nervous system caused by a fall may permanently impair the memory. In such instances epilepsy with mania may ensue and, with the possible exception of the earliest, destroy all memories. Quite often, however, the patient recovers, and sometimes the recovery comes with a suddenness which is astonishing. The recovery may be partial or total, gradual or, as already intimated, the mind may "go back into place with a snap." I find one instance in which no other sign of an impaired intellect was manifested for a long time, except total amnesia. As the patient recovered from the fall his early memories came back very fully, and the retrograde memory returned, while the anterograde memories remained extremely defective. Such experiences force us to think of memories, not of memory; they also show that a memory may be inhibited a long time, but not destroyed. This will become clearer in the subsequent cases described in detail, and has an important bearing upon the relations of the physical to the psychical.

The history of No. III remains to a great extent unknown, and the inhibition in most particulars has disappeared slowly and with difficulty. He appears to be between 60 and 70

years of age. When found in a dazed condition and taken to a state hospital, he gave evidence of pain in the frontal lobes. For this reason his eyes were fitted with glasses, and as a result in a comparatively brief period his headache disappeared and he became rational. With the return of reason, however, he had forgotten his whole past life. He did not know his name, birthplace, parents, or native land. He was in total ignorance as to whether he had a wife and children, or what had been his occupation. His appearance and speech indicated that he was a German, but he could recall neither names nor faces of old friends. There was a long scar upon his forehead, but he knew not how it came there. He learned to read with a readiness which showed that it was a mnemonic process. While reading a book upon the Civil War he saw the name of his old commander and thus realized that he had been in the Civil War. He did not know Grant and Lincoln until he saw their pictures and read of them. A significant experience which associated itself with the name of his old commander gave the key to much of his mental difficulty. This name suggested his being knocked off a moving train by a railroad bridge as he was coming home from the war. Thus the scar upon his forehead and his mental trouble were fairly explained. He also recalls that a physician was kind to him, and remembers having been cared for by Quakers. He was taken to the apothecary

room, where he showed an astonishing facility and accuracy in the handling of drugs. This gave a possible clew to his previous occupation. From a label upon a box he recognized the name of a town in Germany, and associated with it the name of another town which was his birthplace. He is fond of children, but his associations with them have not as yet suggested the names of wife and children. He knows that the name under which he was committed to the hospital is not his true name. A prestidigitator came, and had no sooner begun his performance than this patient called for a silver dollar. He made two or three passes and it was gone, no one knew where. Further performances showed that he had been an expert in other tricks of sleight of hand which readily came back by association. Some minor past experiences have been recalled by dreams, but they are retained with difficulty. He enjoys his protracted effort to gather up the thread of his personal history. It is worth while to note the number of secondary automatic memories which abide. He recalls proper names with great difficulty. The past life comes back in sections, as it were. Certain memories remain distinct, while great clefts in his personal history are wholly void of content. This study suggests also the leading rôle which association plays in remembrance. We must conclude, moreover, that memories may for years lie dormant which, when the physical disability

is removed, come back again. It is difficult to decide when a memory has wholly disappeared. Here, as will be seen later, the motor memories are of a very permanent nature. The certainty of his memories, as definite as they are few, and the probable length of the period in which they were inhibited, makes this a truly classical case.[16] With this patient the mnemonic recovery is slow, but the following instance illustrates the statement already made that memories temporarily inhibited by traumatism may come back suddenly and the entire mind become clear in a brief period.

It is the case of a young man, 18 years old, a laborer and educated in the common schools. He was temperate and there was no insanity in the family. On the 8th day of October, while standing on the top of a ladder 26 feet in length, it broke and he fell to the ground, striking on the back of his head. When committed to the hospital, six weeks later, he could not speak,

[16] William A. White, M.D., who kindly called my attention to this case, has since published an account of it in the *Archives of Neurology and Psychopathology*, vol. i., No. 4.

By means of hypnoidization many memories apparently flashed out from the subconscious life. Dr. White concludes that "The memory pictures of many years have not been ruthlessly wiped out, but that they still exist in that great unexplored region of the subconscious, buried deep beneath the threshold of his personal consciousness, and separated from it by a gulf which no effort of his can avail to bridge."

but could write, manifesting every symptom of motor aphasia. From the time of his accident to the date of admission he was said to have spoken but two or three words. In his written replies he stated that all spoken words seemed as noises to him, but had no meaning. November 19th he writes: "I have caught cold, and when I cough it hurts my head." At 11 A.M.: "The pain in my head has increased." At 11:30 A.M. he went to bed with both hands pressed against his head. The face was flushed and pupils dilated. Suddenly he removed his hands from his head, looked up like a person awaking from sleep, gazed about the room, looked out of the window a moment, and inquired where he was. These were the first coherent words since his injury. "This patient's mind went back into normal position with a snap, so to speak, just as a dislocated bone returns to its socket when it is set by a surgeon." He did not know where he was and recalled nothing since his fall from the ladder. He exclaimed, "Oh, how it hurt me!" as if he had just been injured. A space of six weeks had been a blank. The headache soon passed away and no symptom of brain or mind trouble returned.[17]

An analogous experience was that of an alcoholic patient whom the writer examined. Upon

[17] From conversation with and pamphlets furnished by Charles S. Kinney, M.D., Middletown, N. Y.

returning from the chapel exercises one Sunday he noticed the bars on his windows. Q. "Did you realize anything during the chapel exercises?" A. "I did not." He noticed nothing while going from the chapel to his room, but "As soon as I reached my room all came back to me." Old things had passed away, and behold, all had become new, or rather old, for the real life had been rediscovered and was reinstated in a moment.

Loss of memories due to some form of traumatism shows us how completely memories may become lost, as if blotted out, and, if there were evidence of brain lesion, we would conclude that the memories were erased from the mind never to return. Yet, as the patient recovers, the lost experiences come back, perhaps slowly, as in the case of No. III, or "as a dislocated bone returns to its socket when it is set by a surgeon." Such experiences suggest that while the physical condition may inhibit memories, it is unnecessary to conclude that it destroys them, and prepare us to consider intelligently the subject presented in Chapter IV. Other cases studied, which are not cited here, show that, while the mind may for a long time remain a blank, the earliest memories may first reassert themselves very fully; then other memories, chiefly retrograde, come back as if to dwell again in a deserted home. A question naturally arises as to the validity of Ribot's Law of Regression. Dur-

ing this study I have met not a few physicians skilled in psychiatry who questioned its general application. One hesitates to criticise or question such a writer as Ribot, but there are many exceptions to his law as stated at present. We have already seen that proper names may be remembered better than other experiences, and No. II retained abstract ideas better than concrete. I have interviewed one hundred people between the ages of 65 and 96 to ascertain their earliest memories, and find that a majority of such memories are intellectual with little or no emotional colouring. The memories of No. III have an intellectual cast, and were it possible for him to recall the images of family and friends—memories which are of an emotional tone,—his problem would be solved. It is difficult to state the order in which mental abilities or different memories disappear, for, when inhibited, Omniscience alone can tell in what order they will return. It has been suggested that the law of regression has taken refuge under the popular doctrine of evolution and borrowed from the latter a validity not its own. It is quite possible, however, that the law if enunciated in less general terms would remain valid.

An especial interest attaches to those cases of amnesia due to traumatism or toxic influences which become periodic and are attended by a rhythm of consciousness that at intervals varies in a marked manner. The patient may, as in

the following case, reveal under hypnotic influence a strongly developed subconscious condition, or the two rhythms may receive something like a proportionate emphasis, giving rise to the so-called "double personality."

No. IV, age 14, experienced violent hysterical insanity. There was nothing in her heredity or habits to prejudice the case. When taken to the hospital her field of vision was very much contracted. If an object was shown her which was not in the field of vision she could see it, but she could not determine what it was. The anæsthetic portion of her mental field was connected with a strongly developed subconscious state. Complete anæsthesia could be produced in an arm. If the physician then pinched the arm a certain number of times and asked her to name some number, the number given invariably corresponded to the number of pinches. The same was true of any number of slight sensory impressions, although there was complete anæsthesia. If during hypnosis one engaged her attention and a second person, having come up behind, dictated to her, she would write what was dictated without any knowledge of writing it, and upon coming to herself would not know that she had written or heard it. In the hypnotic condition and distracted states she recalled what had occurred in previous states of this kind. Questions asked in one distracted state were recalled in the next.

When I saw her the field of vision had been completely restored. Her sense of colour was accurate, her mind was in good condition, and she was about to return home.[18] This experience suggests two passages in Waldstein's book entitled "The Subconscious Self": "From the moment of birth—and, in so far as we have seen that organic or splanchnic sensations are communicated to the brain, even before birth—begin the deposit and retention of subconscious impressions in the mind of the child, and so the foundation is laid for the development of that part of man's mental nature which, in the foregoing pages, has been called the subconscious self. . . . In those early impressions of which no one seems to be conscious, least of all the child, and which gather up power as the rolling avalanche, the elements are collected for future emotions, moods, acts, that make up a greater part of the history of the individual and of states, more effective and significant than those that are written down in *mémoirs,* however *intimes,* or that can be discovered in archives, however 'secret.'" That the subconscious self should be more strongly developed in some persons than in others need not create surprise, and how strong this self was in patient No. IV, apart from pathological experience, would never have be-

[18] William A. White, M.D., of the Binghamton (N. Y.) State Hospital, called my attention to the case, which he had carefully studied.

come known. Perhaps a human life grows as a tree grows, and in each successive increments of growth are well defined. When they are felled by force or by disease the conscious layers of the one, like the rings of the other, are found in serial order. A person whose name in early life was J——, but who subsequently bore the name of S——, was injured by being thrown from a railroad train. During the mental confusion which ensued his early name was recalled, but he had forgotten the name S——. When suffering from the injury, his inmost personality, so to speak, J——, came into the foreground, and later the experience of his riper years, when he was known as S——, came back; but it seemed to have been grafted upon the early experience, and in the stress and shock of accident was the first to vanish.

The experience of the Reverend Thomas C. Hanna of Plantsville, Connecticut, is for psychological purposes, the most suggestive that I have met. The advantage is that the subject was a trained psychologist, who after a few weeks entirely regained his mental vigour, and his reflections upon his own experience are invaluable. His father, who is of Scotch-Irish ancestry, has had a long and useful ministry. His mother is the daughter of the Reverend Adoniram Judson and of Emily Chubbuck Judson, who, as Fanny Forrester, wrote the "Alderbrook Sketches," etc. In intellect and promise Mr. Hanna seems

worthy of his ancestry. He was educated at the University of Pennsylvania and at Bucknell University, and has taken a year of postgraduate study at Yale. His statement is as follows: "I fell from my carriage April 15th, 1897. My brother states that it was about 7:10 P.M., and that I was unconscious about two hours. I awoke and was conscious before my eyes opened. By consciousness I mean that my mind was active but had no images to use. I was first conscious of trying to recognize my own breathing. Through the breathing I got an idea of motion and of my power to control myself, for all sense of personality had vanished. This period seemed to be weeks, and what I have since learned was an hour, namely, from 9 P.M. to 10 P.M., seemed to be of several months' duration. My attention was next turned to the beating of my heart. This was the first experience which was not under the control of my will. I wondered what it was that I could not control. Although all of this took place before my eyes were opened, it seemed a great while. I breathed in gasps to see how quickly I could breathe. As soon as I opened my eyes, I opened and shut them quickly several times to note the process. I was interested to know that I could control these movements. I noticed that by moving my eyes around my head turned, and I began to move it back and forth. While moving my head more and more my whole body swayed, my

limbs moved, and I threw my arms back and forth to see what I could do. This frightened the doctors, and one of them moved. This was the first idea I had of any motion not my own. I wanted to learn to control this motion, too. I supposed that it was a part of myself, as everything else had proved to be, and I put my hand out to attempt to repeat the new motion of the doctor. By putting out my hand I thought I could move the physician as a part of my own body. I could not touch him, and reached further and further after him. I began instinctively to get out of bed in order to reach the doctor, who was across the room. He moved again. I continued to reach after him, when another doctor, fearing that I would injure some of them, jumped upon me. It was strange to me, as I had no conception of these beings as persons. The doctor caught me by the throat to put me on the bed. I turned and pushed him away and then turned to another doctor, by which time they were all after me. I had no fear, no thought of revenge. There was no sense of personal danger. I was simply trying to put my will in action against all obstacles. I did not feel pain during the struggle. My first sense of pain was a strained feeling in the chest, owing to my hands being turned behind my back. When my arms were released I felt pain in my limbs, which doubtless had existed all the time. I also felt pain in my bruises. The pain in my

head had existed from the time of my first consciousness, but I did not recognize it as pain until the next day in the evening, when it ceased. This interruption was the first hint I had that the pain was abnormal or a separable part of me.

" Going back to the experience of the first evening, one thing which impressed me was that one person could understand another by speech. I did not know whether it was the motion of the lips, the facial expression, or the sound that enabled them to communicate. It was a question which was the cause, and which accompanied the other. I think the reason for the doubt was that to me the sounds meant nothing while I could interpret the expression of the face. If I did anything which did not meet with approval, I understood the sign by the face of my attendants. When I saw a look of reproach, if it were a kindly face, I would desist; but if the face were stern and severe, it aroused antagonism. I had a sense of right and wrong. I thought that the doctors' treatment of me was wrong when they forced me on to the bed. But my judgment of a person was determined more by his actions than by his appearance. When I realized later that the physicians meant me well, they seemed to be good men. I went to sleep at ten o'clock, had a desire to be quiet, and there was what I now recognize as a condition of deep fatigue." (His brother states that he slept very soundly. The doctors frequently awoke him. At times

his pulse and breathing were so low as to be hardly perceptible.) "The next morning I learned to talk, had a desire to repeat what I heard. I repeated statements of the physicians, e.g.: 'Very bad case,' 'Heart action is slow.' My first word was 'Apple.' I may say in this connection that I did not know how to eat. I took an apple in my hand, not knowing what it was or what to do with it. A person took the apple and ate a little. Then I ate. The word 'Apple' was repeated two or three times and I learned its name. Apple became a generic term for food, and when hungry I called for apple. They then taught me to drink milk and gave me its name. I then had two words for food which came to me when I was hungry, and I saw that they were different. Learning to drink was quite difficult. I thought when they drank they were breaking the glass, and it was some time before I learned that it was simply the liquid that was taken from it. Friday morning they realized that I was not aphasic and began to teach me. I never forgot a word that was told me, and learned to talk rapidly. I had no perception of distance. I would reach out to feel a picture on the wall. I asked for a man who lived four miles away. The village and indeed the world seemed a few rods in extent. My father taught me the idea of time by showing me that the minute hand on a watch went around once in a minute. He taught me what a mile was by stating that one

could walk a mile in twenty minutes. I was taught the meaning of the words father, mother, brother, and sister, and noticed that the manner of these people was different toward one another, but never thought of them as my own. I imitated every act."

At the end of five weeks Mr. Hanna fell from his horse and hurt his back, but this did not affect his mind. "At this time physicians came from New York. I told my dreams to the physicians, and my father recognized among them an experience which occurred before the accident. That was the first hint they had that the past was not erased. I was taken to New York. On the morning following my first night there I came to myself and found myself just as I am now. I was surprised to find myself in a strange room, and my brother beside me." (His brother states that he then talked rationally in every particular.) "When my brother questioned me I recalled all of my life before the accident, but the events since the accident were all gone. I did not know Dr. G——." This state, which for convenience we will call the primary state, continued about twenty minutes. His brother supposed that he had entirely recovered and let him go to sleep. "I recall the doctor's saying, 'Let him go to sleep; he will wake up all right.' After waking I recalled what had occurred since the accident, but nothing of the primary state. But in my primary state my dreams partook of the

secondary state, and *vice versa.* I also had dreams which partook of both states. Subsequently I had three alternations of the primary and secondary states. In each state I feared and dreaded a relapse into the other. I, however, should not have known certainly of the alternations if they had not told me, for in the secondary state the primary state seemed like a dream, and *vice versa.* At length there came a drowsy condition and the two states, the two lives, were presented separately. I looked down the two lives, but never thought I could put them together. The physician said: 'The two experiences are your own. Put them together.' I tried, and they blended into one." [19]

Since within a month Mr. Hanna epitomizes the developing life of the child and adolescent, it is evident that a trained and disciplined mind was worth more to him than stored treasures gleaned through years of toil and study, and it served, indeed, as the efficient means of reinstating the past acquirements. His first efforts to experiment resulting in the ability to distinguish his own motion from that of others, give the hint as to how we all "learn the use of 'I' and 'me,'" and that we "are

[19] Dr. Boris Sidis, who kindly called my attention to Mr. Hanna's experience and was one of the attending physicians in the last stages of his illness, has given a résumé of the case from the standpoint of the physician in his recent interesting book, "The Psychology of Suggestion."

other than the things we touch." The extreme length of the time interval, as it appeared to him, shows how void of all ideas his mind was; this fact suggests that some cerebral process here inhibited is a large factor in determining the time interval and harmonizes with the well-known fact that unoccupied time, or time void of content, seems long during the interval. At first the name of one kind of food designated food in general, until a richer experience rendered it imperative to give a richer content to the generic term. In this he undoubtedly recapitulated the experience of the child and the race. His search for the *cause* of his ability to speak suggests how deeply rooted is our desire to ask the question *Why*. His causal notion as well as his ability to distinguish right from wrong raises a question as to whether such ideas are not innate. They certainly play a leading rôle in his early intellectual efforts. He regained the ideas of space and time gradually through experience. Imitation was an important factor in restoring the mental content. His periods of slight improvement, followed by a noticeable advancement, harmonized with Professor Bryan's experiment in learning telegraphy, as well as with what we believe to be true in learning language. In each case there are intervals of almost a dead level, which are followed by periods of marked acquirement. At the last his recovery came suddenly, when his mind " went back into place

with a snap," to be followed by distinct alternations, which finally unite in response to suggestions into the larger, former, and, so to speak, uninjured self. While we cannot hope to explain the phenomenon of alternating personality, one cannot read Mr. Hanna's experience without recalling the suggestion of Professor James that the phenomenon is really due to a lapse in memory.

As in every-day life, when a person forgets this or that, the expression is used that he is not quite himself, so in the pathological condition there are prolonged lapses of memory. This certainly covers an important phase of the subject. Again we notice that a man who at one time of life is a student of economics, investigating free trade and protection, is a very different person from the same individual at another period when deeply interested in psychology and biology. Then, too, each man determines in early life whether he will become a farmer, mechanic, merchant, lawyer, physician, teacher, minister, or whether he will enter upon some other calling. From a number of possible personalities he decides which one is to develop. If he becomes a specialist, but one is realized. If, on the other hand, he has wide interests, and takes on intellectual breadth, a number of personalities will become subordinate to a dominant one. Great lawyers apparently have a different personality for each

important case with new conditions. Add to this the conception of life as a gradual growth in which the same person is subject to varying moods and feelings arising possibly from unconscious sense impressions, that from day to day he becomes a patriot, money-getter, seer, sociologist, recluse, man of the world, or religiosus by turns, we are not to wonder if at times one large group of experiences gains the ascendency to the exclusion of the others. A factor common to all of the cases of alternating personality here cited is a complete reinstatement of some definite set of associations. Sometimes the associations of the early years gain the ascendency for a period. Again the intoxicated group arises and excludes the others. During somnambulism the associations of business life may become enthroned. At one time the subconscious motor self is ascendant. Again the conscious associations of a definite period of life are reinstated. As in normal life a given association or group of associations takes possession of the conscious field until displaced by others, so in the pathological cases the group of associations which is enthroned takes entire possession of the conscious field to the exclusion of others. If we knew why this field remains stable and not shifting as in other phases of delirium, all could be explained. As it is, lapse in memory, unconscious sense impressions, the conception that mental life is a collection of groups

of experiences, and the tendency in both normal and pathological cases for a definite past group to obtain indisputable possession of the mental field of regard are factors entitled to consideration. Whether, upon the cerebral side, certain portions of the brain are *en rapport* with each of two conscious centres, while other portions are associated with one centre and not with the other, is an hypothesis to be considered later.

The memory of past experiences has been used as a means of curing certain morbid conditions. Drs. Breuer and Freud [20] in treating psychical traumatism (the psychical injury resulting from physical traumatism) found that if they could vividly and completely reinstate the memory of the experience which caused the injury, as soon as the patients mentally represented the process and were able to express it in language the hysterical symptoms entirely disappeared and did not return. Thus the memory which is so frequently interrupted by disease becomes a remedial agency for mental healing.

It has become more evident by this study that we have to do, not with memory, but with memories. Certain of these memories are inhibited by brain lesions; they may be utterly destroyed, but this we do not know, for under more favourable conditions the lost experiences may return. Whether such mnemonic recovery is

[20] "Studien über Hysterie."

exactly proportionate to brain recovery can only be conjectured. The expression inhibition of memories seems to accord more nearly with the phenomenon observed than to speak of the memories as being destroyed. False memories may be due to illusory experiences or to dreams. They assume a great variety of forms under widely varied conditions. These uncertainties of memory are accentuated by loss of ability due to aphasia, and by lesions resulting from toxic influences or traumatism. Yet certain memories, such as the motor and secondary automatic, may be very permanent. The experience of No. III shows that once a prestidigitator always one. Other studies not cited here show that if a man is once a weaver or a tailor he is always a weaver or a tailor. These experiences, which are handed over to the lower nervous centres, apparently remain when all else has disappeared. They belong to the very core of personality, or to the personality of personalities. We may class with these in point of permanency memories pertaining to business and to success in life, while the study of exaltation of memory shows that it is difficult to state when an experience has been forgotten. Memories, both sensory and motor, as well as that phase of mnemonic activity called association of ideas, seem to be important factors in the experience of double personality and appear to afford at least a partial explanation. We have seen that abstract memories and proper

names may be the last to disappear. Moreover, the history of No. III shows that the reasoning power may be intact when few or no memories are present. It seems reasonably clear that the law of regression as at present enunciated does not hold and needs to be formulated in less general terms.

CHAPTER IV

BRAIN AND MIND

I have a room whereinto no one enters
Save I myself alone:
There sits a blessed memory on the throne,
There my life centres.

CHRISTINA G. ROSSETTI: *Memory.*

WE found in Chapter I the question of the relation between brain and mind involved in most of the discussions. From the data given in Chapter II an inference might be drawn that, so far as memories are concerned, both elements develop simultaneously, while in Chapter III almost every page suggested some close relation between the physical and the psychical. It remains to inquire more minutely into this relation and to consider the facts of cerebral localization as well as the office and functions of the brain. We find a wide divergence of opinion as to the extent and importance of cortical localization. It is certain that the visual area comprises the posterior portion of the brain which borders upon the calcarine fissure or terminates in its walls; the auditory area certainly comprises that portion of the superior temporal con-

volution which borders the posterior part of the fissure of Sylvius. The middle portion of the same convolution may also function for hearing. In the tactile sphere some of the motor areas in man are given as follows: in the lateral view the centres for the shoulder, arm, wrist, fingers, and thumb form a serial order along the fissure of Rolando, while directly underneath are the centres for the face and the motor elements of speech.[1] On the mesial plane, beginning in front, the order of the tactile centres is head, shoulder, trunk, hip, knee, leg, ankle, and foot.[1] In the arm and leg areas the centres form the same serial order as do the joints in these limbs. Here in the tactile region terminate all incoming fibres which mediate impressions of general sensibility for the body. Here, too, are the cells which give rise to motor fibres. While the convolution of Broca is the centre for *motor* articulate images, a study of sensorial aphasia shows that another and much wider area functions for the sensory images of speech. The entire speech centre, both sensory and motor, is represented by Mirallié, as in Fig. 2.

All authorities agree that the visual, auditory, speech, and tactile areas are definitely localized. If an animal loses his visual brain area, he becomes blind; and if the auditory region be want-

[1] Professor H. H. Donaldson in the "American Textbook of Physiology," p. 692.

ing, he is deaf. If he loses the "arm centre," he cannot use the corresponding limb at all, or only in the most feeble manner, nor can he ever recover. The instances of recovery reported years ago were due to an imperfect operation. When a man loses his motor or sensory speech centre he cannot talk. The auditory area is of

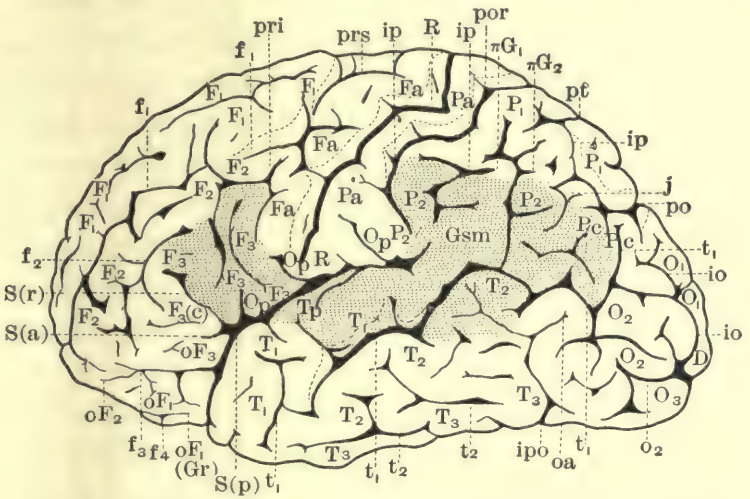

FIG. 2.—The above representation is borrowed from "L'Aphasie Sensorielle," by Mirallié, p. 109. The shaded portion represents the speech area upon the cortex of the left hemisphere.

extreme importance. A lesion here renders the patient unable to speak. Examples of partial aphasia show that those words are best preserved whose motor images are most used and best united with auditory images. Our idea of the word then must depend upon motor plus auditory images, and the motor speech centre

must be associated in some way with the temporal region. That there are separate centres for the spoken word and the word as heard, seen, and written was first announced by Charcot and may now be considered as established. If there be a lesion in the centre for auditory or visual images, the patient is unable to comprehend the meaning of the auditory or visual presentation, and has verbal deafness or verbal blindness. If, on the other hand, there be a lesion in the convolution of Broca, the patient cannot pass from the visual or auditory idea of the word to the motor act of articulate speech. Moreover, if the auditory area be wanting, the person loses, apparently on account of this defect, the ability to understand, because he has no longer the power to distinguish words.[2] As soon as we leave the areas for sight, hearing, touch, and speech we enter upon debatable ground and can be guided by no consensus of opinion. Yet individual writers, whose very names carry weight and authority, would go farther. Spatial ideas may be localized[3] in the angular gyrus, yet in so far as the ideas of space involve visual and motor elements these areas are also concerned. The fact that musical aphasia or amusia always involves the loss of speech, while motor aphasia and even verbal deafness may exist without im-

[2] Wernicke, also Hermann Munk.
[3] Wernicke and Exner.

pairing the musical ability, suggests that the musical centre was developed before the speech centre. They are undoubtedly located near each other. The further consideration that right-handedness develops before speech in the evolution of the race, and that the centre for the hand most used is located upon the same hemisphere and in close proximity to the motor centres for speech and music, may explain the close relation existing between speech and gesture.[4] Sensorial musical aphasia appears to be coextensive with the auditory area, while its motor centre has been placed in the foot of the middle frontal convolution.

The views of Flechsig upon localization are radical and differ widely from those of other neurologists. The reader who desires a detailed knowledge of his theory will find the charts given at the close of the chapter to be serviceable. His views are based in part upon the results of his studies of the developing brain which have shown that not all portions of the cortical region have fibres of projection whose function is to connect them with the basal ganglia and the spinal cord. He accordingly divides the cortex into two distinct spheres, one of which is designated as sensory areas or projection centres with which the fibres of projection are *en rapport.*

[4] For a fuller discussion of this subject see "Mental Development," by J. Mark Baldwin, pp. 438 ff.

These centres comprise the visual, auditory, and tactile areas, which, as will be seen by consulting the charts to which reference has been made, do not differ widely from the descriptions of similar centres as given by other authors. It will be noticed that the tactile centre (Körperfühlssphäre) in man is much more extended than all of the other sensory regions. The other great divisions of the cortex are called the associational centres, which are supposed to be united by association fibres to the sensory areas and to connect different parts of the same hemisphere. While about two-thirds of the cortex in man is occupied by the associational centres, these areas grow smaller as we descend the animal scale; only one-half of the monkey's cortex is supposed to mediate association, and the principal characteristics of these centres, as they appear in man, are wanting in the rodents. Flechsig's reasons for concluding that these regions have an association function are: (1) they are more extensive as we ascend the animal scale; (2) they begin to function late, as is shown by the period when the fibres become medullated. The sensory areas develop before the associational centres. In the brain of a child one month old the medulla and crura are fairly well medullated, while there is some degree of medullation in the basal ganglia and in the visual and tactile areas.[5] At the end of two weeks the

[5] Flechsig, "Gehirn und Seele."

auditory area is not medullated so far as the cortex, although at this time the cortical visual area has become to a slight extent functional.[6] At the age of three months the area for smell is well medullated, and at five months of age the associational centres have become to a considerable degree functional.[6]

This theory carries the question of localization to the extreme. At present, while there are eminent authorities who, to a greater or less degree, indorse these views, yet the theory is strongly combated by most neurologists. I saw in the laboratory of Dr. Hermann Munk of Berlin a monkey which at two different times—eight and ten months previously—had lost the entire association centres as described by Flechsig; yet a committee of the leading neurologists of the world would be unable to distinguish the animal from the soundest creature of its kind that roams the forest. While one feels, when attending Professor Flechsig's lectures, that he is always in the vicinity of what is new and important, yet it is too early to adopt the theory as a whole. It may contain important truths, but we must wait for its wider development and for the refining hand of time to separate the dross from the pure metal. If this view proves to be correct, we have not only a physical basis for idea association and for the finer feelings

[6] Flechsig, "Gehirn und Seele."

and will impulses, but the myriads of memory images (Erinnerungsbilder) assumed, form a basis for and give at least a partial explanation of all memories. We may have a partial clew at least to the explanation of the gradual unfolding of the mental capacity of the child. Does the nascent intellect dawn gradually as functional power is slowly acquired in the neural mechanism? Does this slowly developing mental power correspond phylogenetically to the evolution of mind in the race? Are there possibilities for the increase of mentality in middle age owing to the development and medullation of portions of the cerebrum hitherto unused? It may be early to draw conclusions, but the subject is full of psychological and pedagogical suggestiveness.

It will be convenient frequently to refer to the different levels of Hughlings Jackson. His lower level, comprising the spinal cord and the nuclei of origin of the cranial nerves, mediates reflex acts. The second or middle level corresponds anatomically to the basal ganglia and the sensory cortical centres of Flechsig. It receives the simple movements of the lower level and combines them into higher and more complicated movements. His highest level was supposed to be represented anatomically by the remainder of the cortex. It probably is the basis of the higher mental operations.

The courses of the subcortical impulses also

have been partially traced through nerve degeneration. For convenience the central nervous system is distinguished [7] from the peripheral system. The central system comprises the nerve mass enclosed in the cavities of the cranium and the vertebral canal. The peripheral nervous system comprises the spinal and cranial nerves with their ganglia. A sensory impulse cannot give rise to a motor impulse until it enters the central system. The afferent or centripetal cells carry impulses due to peripheral stimuli to the central system. The central cells distribute the impulses received from the afferent cells. The efferent cells convey impulses from the centre to the muscles and other efferent terminal organs. Neurites from the afferent peripheral cells, upon entering the spinal cord, run both cephalad and caudad.[8] The chief central sensory paths are composed of elements whose neurites run cephalad. New fibres come in to swell the volume as the path ascends. These fibres by a series of relays traverse the spinal cord, decussate in the medulla, and, passing to the midbrain by the lemniscus, go to the sensory cortical centres. The lemniscus or fillet arises from the funiculi gracilis and cuneatus. About its cells of

[7] Professor H. H. Donaldson, "American Text-book of Physiology," p. 639.

[8] *Ibid.*

origin terminate the neurites of the lower sensory cells. Near its terminus arise new cells to convey the impulses to the cortex. We have, then, not a single cell, but a chain of cells or system of relays which constitute the sensory path.

The efferent or centrifugal impulses come from the cells of the cortex of the tactile regions, descend through the inner capsule, down the crura on the same side to the medulla. Some of the fibres are continued directly down the ventral and lateral columns of the cord, while the greater part decussate, and having crossed the median line, giving off collaterals, go down the lateral column of the cord, finally coming into contact with the motor cells, which carry the impulses out of the ventral roots of the cord to the voluntary muscles.

A most delicate and complicated mechanism is employed to carry an optical excitation to its cortical centre. The impulses are usually carried to the first optic centres by three sets of neurones. (Fig. 3.) One set of neurites terminates in the optic thalamus, another in the external geniculate body, and still others in the superior quadrigeminal body. Near their terminations are other cells which convey the impulses to the occipital area. According to Flechsig those which come from the external geniculate body are the fibres which convey impulses from the macula lutea of the retina, the most sensitive portion in man. They terminate

in the walls of the calcarine fissure, while the fibres which are *en rapport* with the optic thalamus and the superior quadrigeminal body ter-

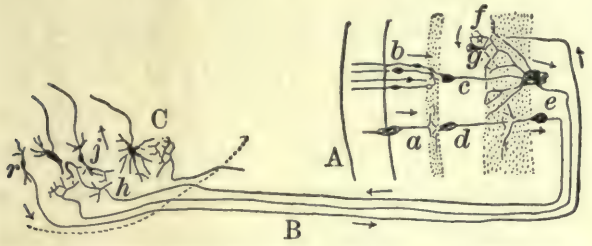

FIG. 3.—Schema of the path which the nervous excitation takes along the cones and rods to the geniculate body. *A*, retina; *B*, optic nerve; *C*, geniculate body. *a*, cone; *b*, rod; *c*, bipolar cell making connections with the rod; *d*, bipolar cell connecting with the cone; *e*, ganglionic cell; *f*, centrifugal nerve-fibre; *g*, spongioblast; *h*, free arborization of fibres coming from the retina; *j*, nerve-cell whose protoplasmic cluster receives the excitation conveyed by way of the optic fibres; *r*, cells from which centrifugal fibres probably arise. The points of the arrows indicate the direction of the impulses. (From "New Ideas upon the Structure of the Nervous System in Man and Vertebrates," by S. Ramón y Cajal, French translation, Paris, 1895.)

minate in the cerebral cortex bordering upon the calcarine fissure.

The auditory nerve has two divisions. The termination of the upper division—the vestibular—is in the outer auditory nucleus beneath the lateral angle of the fourth ventricle. It sends out processes which terminate in the cerebellum and in the superior olive. It does not go to the cerebral hemispheres and has nothing to

do with hearing. It is a reflex nerve, and probably mediates movements. The lower root—cochlear—terminates directly, or by way of the auditory striæ across the floor of this ventricle, in the inner auditory nucleus. From the deep origin it ascends the lateral part of the fillet, and the largest portion goes to the lower quadrigeminal bodies; another and smaller portion goes to the upper quadrigeminal bodies, and a portion smaller than the first-named terminates in the inner geniculate bodies; then from both the lower and upper quadrigeminal bodies paths go directly to the inner geniculate bodies, where all of the impulses unite, and go past (not through) the inner capsule to the cortex and terminate in the Hörsphäre on the floor of the Sylvian fissure, being limited to the back part of this area.[9] The vestibular division is probably concerned in equilibrium only; the cochlear division is supposed to mediate tunes as well as sounds. Motor or centrifugal fibres pass from the auditory area to nuclei in the pons. This may be a motor path to transmit certain impressions received in the auditory area to the muscles of the ear.[10] In the mid-brain some of the auditory neurones must communicate with optic fibres and mediate the close relations between sight and sound.

[9] O. Fischer, Leipsic.
[10] Flechsig.

It is pertinent to our subject to inquire what constitutes the difference in brain structure between the normal person and the idiot. It is probably not richness of convolutions, for the brain of the idiot may be as rich in convolutions

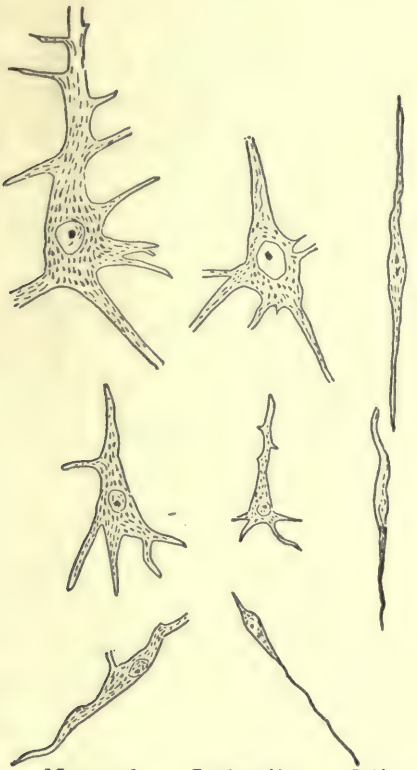

FIG. 4.—Represents, according to Hammerberg, the relative size of cells in the brain of a normal person, an imbecile, and an idiot.

as that of Gauss. The chief difference lies in the number and quality of the brain-cells. Ham-

merberg has shown that in the brain of an intelligent man the cells are numerous and large. (Fig. 4.) In the brain of the idiot he found the cells to be fewer. In the lowest degree of intelligence the cells are very few and seem to decrease in number and size with lessening intelligence.

The dendritic portion of the nervous system, whose function may be trophic,[11] but which probably receives and transmits[12] impulses, is most highly developed in man and decreases in complexity as we descend the animal scale. (Fig. 5.)

The nerve impulse may originate in the body of the cell or at any point of its several processes.[13] When started, it does not necessarily pass from one cell to another, but new impulses are generated in the successive elements in the chain,[13] each cell acting as a storage battery to reinforce the impulse. Neural impulses thus generated in the body of the cell or at certain points of the processes pass along the nerve-fibres. The chain of impulses may have several paths of discharge from which to choose. It may, on the other hand, discharge through a number of paths and become diffused. As will be seen in the next chapter, these factors have a bearing upon the workings of the consciousness in mem-

[11] Golgi. [12] S. Ramón y Cajal.
[13] Schäfer in *Brain*, 1893.

ory. It becomes apparent that those cells or portions of cells which are most used will function most easily and convey the impulses by force of habit. Thus paths of neural impulses may become formed in the brain and the impulses tend

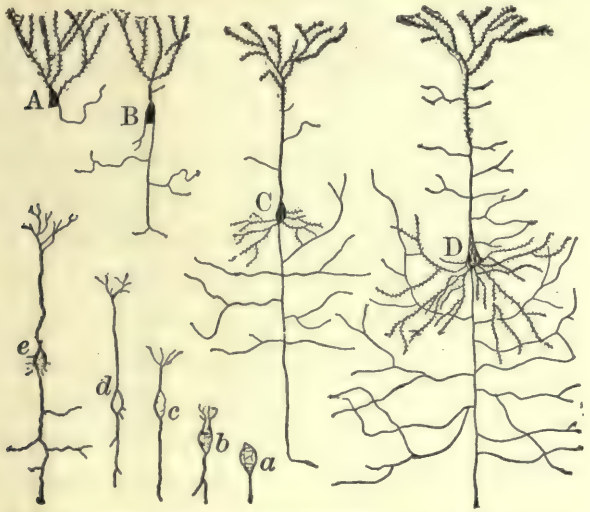

FIG. 5.—Illustrates the phylogenetic development of mature nerve-cells in a series of vertebrates, and the ontogenetic development of growing cells (pyramidal) in a typical mammal. *A*, frog; *B*, lizard; *C*, rat; *D*, man. *a*, neuroblast without dendrites; *b*, commencing dendrites; *c*, dendrites further developed; *d*, first appearance of collateral branches; *e*, further development of collaterals and dendrites. (From S. Ramón y Cajal, per Donaldson's "Growth of the Brain.")

to follow beaten paths, as cattle wind their way over a hill. The cells tend to be modified by use, and on the neural side form the basis of habit and memory. That use is intimately connected with and may precede structure may be inferred

from Professor Donaldson's study of the brain of Laura Bridgman. He writes: "It must be recalled here that although at the age of two years Laura became completely blind in her left eye, yet she retained some remnant of vision with her right eye up to her eighth year. This has left its mark on the entire central apparatus for vision. The right optic nerve is larger than the left. . . . On the one hand we have loss of vision in the left eye at two years of age, associated with smaller optic nerve and tract, a defectively developed right occipital lobe, and a thin cortex in the right visual area. On the other hand we have some vision in the right eye up to the eighth year of age, associated with the larger optic nerve and tract, the more normal occipital lobe, and the thicker cortex."[14] Both sides of the Laura Bridgman cortex were very thin in the auditory area, and the areas for taste and smell were poorly developed. There were few nerve-cells in the auditory areas on both sides, and in the visual area on the right side. There was also a diminution in the number of cells in the areas for taste and smell. The small number of cells was associated with the small size of the largest cells.

The cortex which works so constantly and performs the most delicate functions is a little less than three millimetres in thickness. Di-

[14] *American Journal of Psychology*, vol. iv., p. 259.

rectly underneath the pia is a layer of neuroglia cells. Next comes the layer of small pyramidal cells, which are found in great profusion in the eighth month of fœtal development.[15] (Fig. 6.)

FIG. 6.—To show the developing human cortex (Vignal). ×40 diameters. *A*, fœtus of 28 weeks; *B*, fœtus of 32 weeks; *C*, child at birth; *D*, man at maturity. I—V, layers of the cortex according to the enumeration of Meynert. (From Donaldson's "Growth of the Brain," p. 239.)

Next comes the layer of large pyramidal cells, some of which develop in the seventh month.[15]

[15] Vignal.

They give rise to motor or centrifugal paths in the sensory centres. Last comes a layer of polymorphic cells, which may give rise to association fibres. This layer is but slightly developed at birth.[16] To the cortical cells apply the words of Professor James, who speaks of the cortex as "The mouth of a funnel, as it were, through which the stream of innervation starting from elsewhere pours, consciousness accompanying the stream and being mainly of things seen if the stream is strongest occipitally, of things heard if it is strongest temporally, of things felt, etc., if the stream occupies most intensely the motor zone."[17] The chief theories of the physical basis of consciousness are: (1) that of Lewes, who holds that the nerve process is irritable and is therefore conscious.[18] He believes that each nerve-centre has its own consciousness, and that the consciousness of the individual is only the outcome of many lower consciousnesses. The other theory is that a given degree of development is necessary before consciousness appears.

The brain of the child grows rapidly. By the seventh year it has reached approximately its full weight, and the subsequent increase is small, "The same weight of the brain continuing up to

[16] Vignal.

[17] "Psychology," vol. i., p. 65.

[18] J. Mark Baldwin in "Elements of Psychology," vol. i., p. 62.

the onset of old age, when there appears a loss in weight, which becomes rapidly more evident."[19] The weight of the brain does not necessarily determine intelligence. Professor Donaldson gives the brain-weight of forty-five men of eminent ability. He concludes that there is no evidence that persons who have large brains are the most intelligent; yet a small brain is frequently associated with little intelligence. "Education must fail to produce any fundamental change in the nervous organization, but to some extent it can strengthen formed structures by exercise, and in part awaken into activity the unorganized remnant of the dormant cells."[20]

Dr. Hodge has proved that when the brain is fatigued the nucleus of the cells shrinks in size and the protoplasm does not stain so easily and becomes vacuolated. On the mental side also the effect of fatigue is marked. In Chapter III an account was given of a man who, after becoming exceedingly fatigued from riding his wheel, lost his memory. Carpenter relates that a man who had become completely exhausted in a mine lost his knowledge of the German tongue. Mountain-climbers are obliged to note down their impressions at once while on the mountain peaks, as they suffer a lapse of memory due to fatigue.

[19] Professor H. H. Donaldson in "The Growth of the Brain," pp. 133, 134.

[20] *Idem*, p. 343.

Perhaps a few inferences may be fairly drawn from the foregoing statements: (1) Definite areas of the central nervous system have a special work to perform. (2) In the course of development it is probable that use has preceded structure. (3) The lowest and middle levels—the oldest and best established—function earliest in the child. In this respect perhaps the child recapitulates the experience of the race. (4) There is a strong presumption that the highest level of Hughlings Jackson or the association centres of Flechsig is the portion of the brain concerned in association and in the higher memories. (5) No amount of training can hope to give good mentality and memory if the brain-cells be few or poorly developed. (6) While the processes of brain development, such as medullation, progress very rapidly at first, there is a possibility of new memories as long as there are brain areas which are not developed. (7) All mental acquisition, in order to be effective, must stop short of the point of extreme fatigue. (8) Brain localization suggests that we have not perception but perceptions, not memory but memories

In order to obtain a wider view of the subject it may be serviceable to restate the leading theories of the relation of brain to mind.

The first theory is the vague dualism held by the common people of practically all races. It assumes, as an underlying substance and unity,

an immaterial and indestructible soul. Every language, perhaps, has a word to express it. Ancestor worship implies a belief in its existence.

If we stand by a deathbed and note the mind present in all its power and ten minutes later see a lifeless body, as deaf to suggestion as a stone, it is natural to infer that the elements which we consider as constituting the soul have departed as a separate entity. So long as people die, so long the belief in an immortal soul, taught at a mother's knee, will be cherished. It is true, however, and to be regretted, that the term soul has largely disappeared from modern psychology. Yet they are not wholly responsible for the disuse of the term who do not believe in its existence. The psychology of today aims at exact methods. It proceeds from the known to the unknown, from the concrete to the abstract. It is claimed that if the conception of a soul with certain powers or faculties be introduced into psychology, the very facts are thereby assumed which it is the aim of physiological psychology to investigate. The old "mental science," with its manifold divisions and abstractions, was understood by no one and has been well styled "A Museum of Antiquities." The new psychology, which deals with the concrete, is a part of inductive science and breathes of its spirit and life. It must be conceded that by certain expressions, such as *psychical phe-*

nomena, the same processes are often designated as by the *soul and its activities*. Whatever we may personally desire in the matter, psychology will never again be dominated by preconceived epistemological ideas. These will have a place, but not in psychology. Having failed to make any appreciable advance by assuming the unity which it sought to prove psychology has turned to the study of phenomena in the hope of adding something to the sum of truth. While the study of phenomena will not answer our deepest questionings until the root of our nature has changed, while we may say with Paulsen, "The good and perfect towards which the deepest yearning of my will is directed forms the origin and goal of all things, inasmuch as this certainty does not come from science, science cannot destroy it," yet it must henceforth remain chiefly the province of psychology to deal with phenomena, while metaphysics busies itself with the why.

There are two kinds of ontological monism—materialistic and idealistic. The desire is strong to reduce apparent forms of reality to one principle. Materialistic monism holds that matter and movement constitute reality. According to this theory, states of consciousness are phenomenal forms of physical processes, and the mind is an epiphenomenon of the brain. All psychical states are reducible to physical states. Physical science shows that motion is transformed, but

that the sum of molecular energy remains constant. Indestructible matter and the motion in matter are, then, all the reality that is known. Sound, light, heat, and electricity have been reduced to modes of motion. Why may not this law obtain in the field of consciousness? When the matter which composes the nervous organization ceases to produce motion, the mind will cease. Individual immortality must be given up. Psychology becomes physiological in character. Biology shows that life originated somewhere, perhaps upon the surface of the ocean, and as it had a beginning it will also have an end. This is perhaps a fair statement of the theory of interaction which assumes that the brain is invariably the causal factor. Man becomes a conscious automaton. To quote the words of Prof. Huxley: "The soul stands related to the body as the bell of the clock to the works, and consciousness answers to the sound which the bell gives out when it is struck. . . . Thus far I have strictly confined myself to the automatism of brutes. It is quite true that, to the best of my judgment, the argumentation which applies to brutes holds equally good of men; and therefore that all states of consciousness in us, as in them, are immediately caused by molecular changes of the brain substance. . . . We are conscious automata." [21] It would be a mistake to assume

[21] Cited by Professor James, "Psychology," vol. i., p. 131.

that the psychologists who adopt this hypothesis are iconoclasts. They have reached their conclusions—conclusions not always welcome to the individual—by reason of intellectual honesty and a desire to employ methods in the psychical field which are used elsewhere. It may be added that the theory makes for unity of treatment and is held by some very able as well as honest investigators. I cannot think, however, that by following up a physical series we shall ever arrive at a psychical series. The words of Du Bois-Reymond are applicable here. "Motion can produce motion only or transform it back into potential energy. The mechanical cause entirely disappears in the mechanical effect." In other words, physical motion remains physical in some form, and if it could become psychical it would cease to be what it was previously in kind and quality. Moreover, the theory and its corollary contradict a very fundamental racial instinct. Psychology does not concern itself with immortality, but it is forced to deal with all psychical phenomena. Now, the longing for immortality is a prominent and perhaps universal phenomenon. It may be classed among the passive instincts of self-preservation or defence. As these inherited longings are constantly assuming a larger psychological importance, we cannot adopt the theory which stands in direct antagonism to them.

Idealistic monism puts mind before matter and

maintains that matter may be a development of mind, but it cannot cause mentality. The physical world is merely the phenomenal form of the true reality. Mentality is the noumenon. This appears to have been the view of Plato, Leibnitz, Fichte, Haeckel, Fechner, and others. Perhaps the view of Spinoza may be placed here. This theory takes cognizance of the manifestations of mind. If, says Paulsen, we take from our libraries the works which pertain to the mind, we shall reduce the number very considerably. We see the marvellous inventions of to-day and realize that mental acumen, not physical force, is the factor most in demand and the best paid. The theory, however, is epistemological rather than psychological, inasmuch as it institutes an inquiry into the origin and nature of reality. It belongs to the realm of metaphysics.

The last hypothesis to be considered is that of parallelism. This theory holds that there are two parallel series of physical and psychical phenomena which we find running near each other, but never interacting. Mind does not influence matter, nor matter mind. Hughlings Jackson has maintained this theory like a scientist, and it is supposed to be the orthodox position. Leibnitz's illustration of two clocks may be modified as follows: (1) The machinery of the first clock may move the second. (2) The machinery of the second clock may move the first. (3) Both may be run by the machinery of a third. (4) The two

may have been so constituted as to run together without each influencing the other. The last illustrates the preëstablished harmony of the doctrine of parallelism. The psychical does not influence the physical any more than the steam-whistle exerts an influence upon the machinery to be set in motion. The physical exerts as little influence upon the psychical. If this theory be correct, we may ask, in the language of Leibnitz, what is the sufficient reason for the two series existing together? When in the lower animals there is little neural development and the forebrain is reduced to the olfactory lobes, the stream of consciousness is not large. As the forebrain grows and associational areas develop, intelligence increases, while both the neural mechanism and the accompanying consciousness appear at their best in man. From the time that the first ganglion appears, yes, as we have found in the monera, and for aught we know in the sensitive plant, a mechanism of some kind may be accompanied by consciousness of some degree, while those are not wanting who posit conscious atoms in the primitive nebula. Do the two processes flow on forever parallel, the two streams widening and narrowing at similar distances, yet forever separate? Such questions any theory of parallelism must answer. It is true that certain advocates of parallelism understand by the term that the two phenomena may be closely

related, but that we can know nothing about the relation. This theory has the merit of affording a convenient retreat for work, free from seeking causes of interaction, and is severely logical. It is, however, hardly in harmony with the teachings of physiology. These objections are raised, not that a better theory may be offered, but to show that any theory which states the relations of brain to mind in the present state of knowledge is imperfect. Any hypothesis is beset with difficulties. Moreover, we must bear in mind the classical passage of Tyndall. "The passage from the physics of the brain to the corresponding facts of consciousness is unthinkable. Granted that a definite thought and a definite molecular action in the brain occur simultaneously; we do not possess the intellectual organ nor apparently any rudiment of an organ which will enable us to pass by a process of reason from one to the other."[22] If this be true, why formulate any hypothesis, as nothing can result but one more flight in a vacuum? The answer to this objection is, if there is to be unity of treatment, many facts to be considered must be grouped around one hypothesis. If we are to enter the psycho-physical field at all, it must be by the use of an hypothesis. It behooves us, therefore, to employ the one which bids fair to harmonize the greatest number of facts. Moreover, in the light of recent achieve-

[22] Cited by Professor James.

ment, it is too early to assert that what is not at present known will forever remain a shadow. The despair which is settling down over the new psychology in regard to determining this relation is not in harmony with its splendid achievements. Cerebral localization, the painstaking physiology of the senses, reaction time, determination of the span of consciousness, the contributions upon space perception and retention, have cleared the way. To the new psychology the new century turns with confidence and hope. It may seem to have been implied in these pages that metaphysics has completed its task. That this is not true, Schurman, Royce, Bowne, and others daily prove. All that has been attempted is to claim an open and untrammelled field for psychology. Less it will not accept. This much epistemology cannot deny. Truth will never antagonize truth. Error will not promote, nor will truth injure, a righteous cause. Whatever contributions epistemology may make, empirical science will welcome. If, however, they are to work together, a new survey must be made that they may tunnel from the opposite sides of the mountain. Then let each contribute its share and they may meet, perhaps not at the centre, but they may meet, and the march of intellect go on. To psychology there comes a refreshing freedom when the mind is regarded as a whole. Truly it is a whole, a living whole, but its development is determined by its environment. Place it up

above the rich earth and it blooms like an orchid; on a barren rock it becomes an oak; while in a luxurious garden, carefully nurtured, it becomes a century plant growing and blossoming to the last.

Whatever hypothesis may be adopted of the relation of mind to brain, it must take cognizance of the fact that the relation is a close one. Otherwise the mass of neurological facts just cited is meaningless. If a wire be twisted, it subsequently may be straightened, but the molecules will not resume their original position. The earth's crust is permanently altered by the vibrations of an earthquake. If the surface of a lake be disturbed or the air be set in motion, the molecules will not resume their original position. A Stradivarius used by a virtuoso has qualities which an instrument unused by an expert does not possess. If a crystalline salt be dissolved, it will recrystallize, but the crystals will not have the identical position previously held. But here a law is introduced—the salt recrystallizes in the same geometrical form which it had before dissolution. The previous examples illustrate fixation. The last is a case of reproduction. The salts recollect, as it were, their original geometrical form. Memory and other mental powers improve, as we have seen, as the brain grows and fibres become medullated. Perhaps there is no presentation which does not leave some trace or registration in the delicate and plastic tissue

of the nervous system. It is fair to suppose that the more certain thoughts are dwelt upon the greater are the corresponding neural modifications. Wundt, James, and many other psychologists accent the power of habit in the nervous organism. It may not be wholly figurative to state that neural paths are worn deeper by reflection and education, and that the molecules become rearranged, perhaps never to resume their original form. We can accept the statement, moreover, that there are no psychoses without neuroses, and go further than Ribot is willing and affirm with Pflüger and Lewes that there are no neuroses without psychoses. Perhaps that was not wholly a dream of De Quincey, Swedenborg, and Coleridge that the angels would come in the judgment day and take a complete record of our lives from the traces left in our bodies and nervous systems, and that by these we should be judged. If these are the books which are to be opened, a record trustworthy enough to determine destiny will be found. Each record in itself makes destiny. There is, I believe, no conscious memory to which the brain is not an indispensable condition. As surely as the electric spark is not independent of the battery, so surely is no memory independent of the neural substance. By the statement that the nervous substance conditions mental processes it is not intended to suggest that the nerves are the cause and

that mentality is the effect. The brain is an indispensable condition, but, to use the language of Hering, "I do not say cause, for this I do not know." It is not for psychology to assert whether mind or matter gives rise to the other or which constitutes reality. These rocks are chiefly on the side which epistemology is to tunnel. Back in the twilight of existence the biologists find that they possibly may exist together, although at what time in the chain of being consciousness is found there is no consensus of opinion. Certainly in very low stages of life, mind and matter are associated; and as we ascend the scale of being to man we find them apparently varying alike in volume and power.[23] I assume, then, a condition which I shall designate as genetic parallelism. By this is meant that in the successive stages of development the two phenomena are found parallel, and also that psychology cannot state which gives rise to the other. I further posit functional interaction as the theory which, upon the whole, best conforms to the many facts observed in this and previous chapters. Putting the two together, the hypothesis which most strongly appeals to me as the one best able to harmonize the mass of data considered may be styled Genetic Parallelism and Functional Interaction. At the beginning

[23] Not absolute increase in brain weight, but the proportionate increase of the size of the brain to the body is meant.

of the next chapter a schematic outline will be given to illustrate the manner in which I conceive that this relation may exist. Assuming that the phenomena are genetically parallel, no attempt will be made to inquire into the reality of either phenomenon or its genesis. These are ontological and metaphysical questions. I shall only attempt to illustrate briefly a possible functional relation which has been inferred from the data accumulated in the first four chapters.

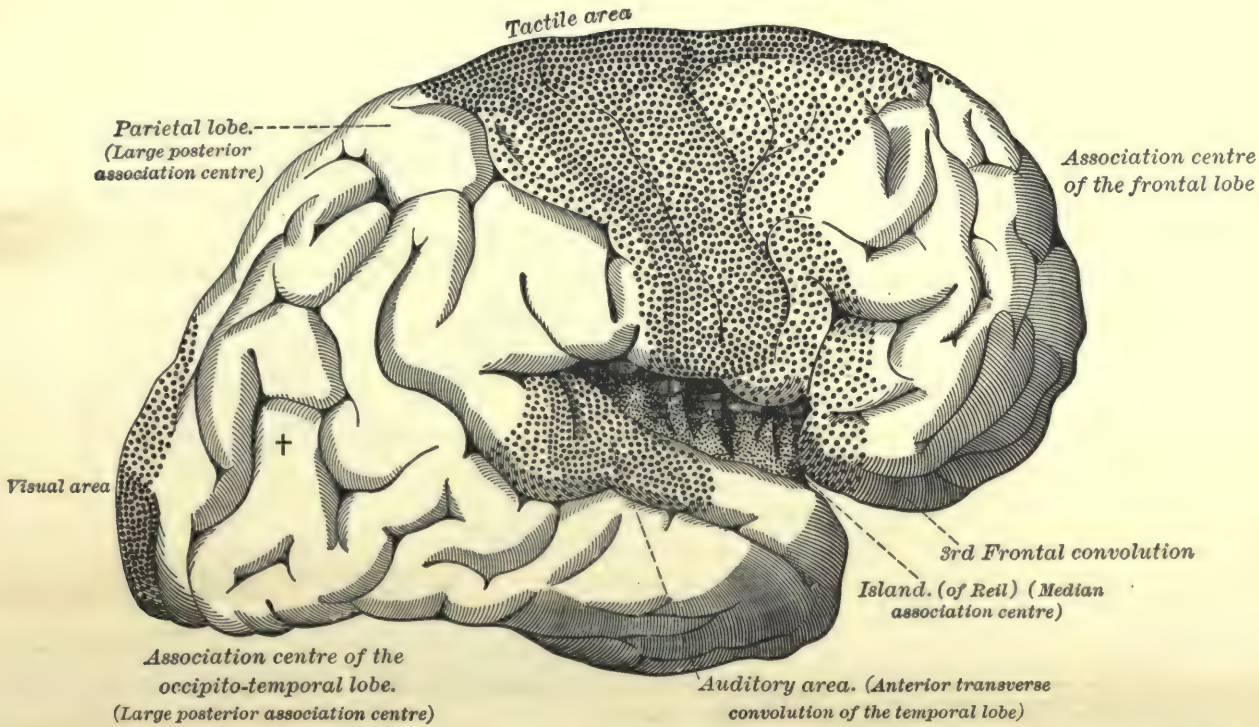
Tactile area
Parietal lobe.
(Large posterior association centre)
Association centre of the frontal lobe
Visual area
3rd Frontal convolution
Island. (of Reil) (Median association centre)
Association centre of the occipito-temporal lobe.
(Large posterior association centre)
Auditory area. (Anterior transverse convolution of the temporal lobe)

FIG. 7.—Cortical view showing the sensory areas of Flechsig. These are indicated by dots, and the areas in which the dots are thickest are those in which the most of the sensory paths terminate.

(*Page 171.*)

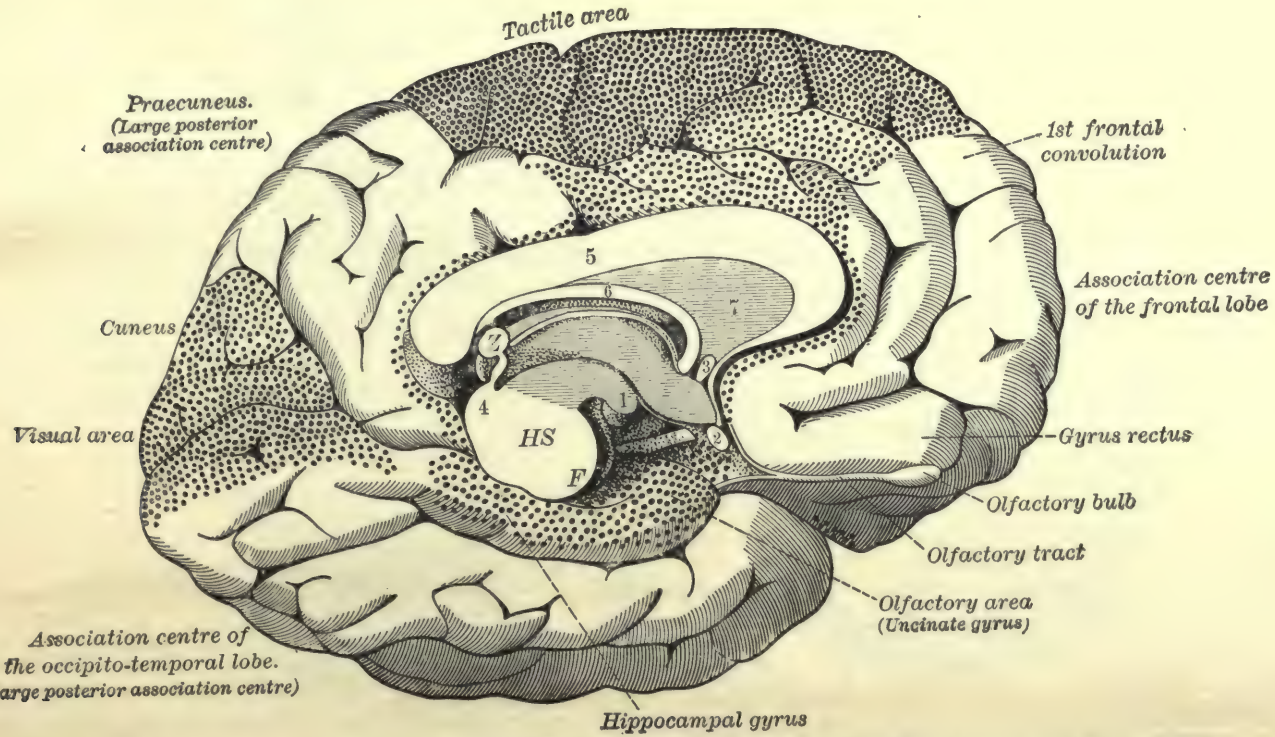

FIG. 8.—Mesial view showing the sensory areas of Flechsig. The dotted areas are those which Flechsig designates as sensory. The portions which are terminal areas for the greatest number of fibres are most thickly dotted.

(*Page 173.*)

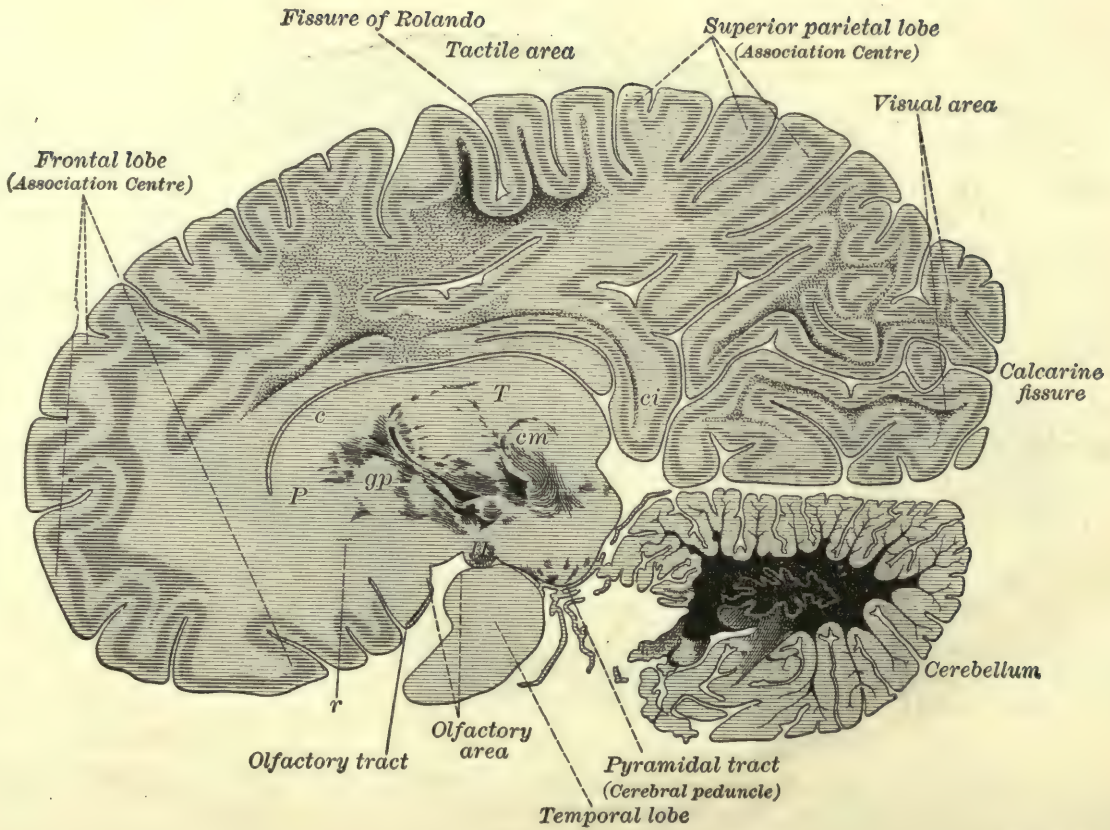

FIG. 9.

(*Page 174.*)

Explanation of Fig. 9.

A mesial section through the brain of a child that died at the age of one month. The black and dotted portions represent areas of medullated fibres. The two dark bands in the visual area represent medullated fibres radiating from the outer geniculate bodies and conveying impulses from the macula lutea of the retina, the area of clearest vision. The fibres of the tactile area and those passing in the vicinity of the basal ganglia are fairly well medullated. Another section (not given here) through the same brain shows a large amount of medullation in the spinal cord, medulla, and crura. The lower quadrigeminal bodies were better medullated than the upper.

c = Caudate nucleus.
gp = Globus pallidus of the lenticular nucleus.
P = Putamen of the lenticular nucleus.
T = Optic thalamus.
ci = Gyrus cinguli.
cm = Corpus mamillare. (Corpus albicans.)
r = Bundle of white fibres going from the olfactory bulb to the lenticular nucleus.
II = Cross-section of the optic tract.

(*Page 174a.*)

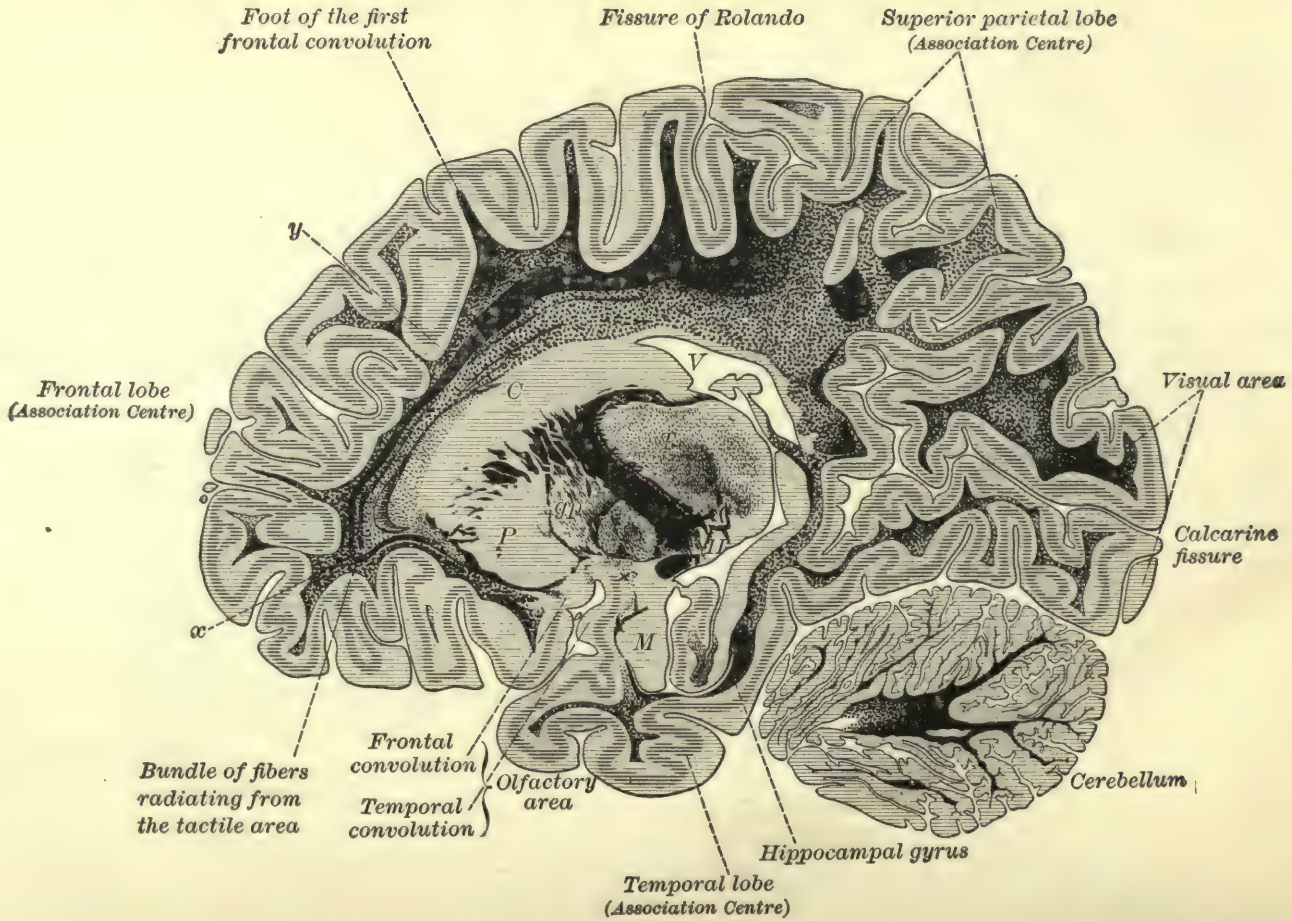

FIG. 10.

(*Page 174b.*)

Explanation of Fig. 10.

A mesial section of the brain of a child that was said to have died at the age of five months. By comparison with Fig. 9 the large area of dark bands indicates how far medullation has progressed from the beginning of the second to the end of the fifth month. All portions of the white matter are medullated, but in every region unmedullated neurites are found.

C = Caudate nucleus.
P = Putamen of the lenticular nucleus.
gp = Globus pallidus of the lenticular nucleus.
T = Optic thalamus.
V = Lateral ventricle.
II = Outer geniculate body.
M = Amygdala
X = Substantia innominata of Reil.
x–y = Bundle of fibres radiating from the upper and inner part of the frontal tactile area. This part in Fig. 9 is not medullated.

(*Page 174c.*)

CHAPTER V

MEMORIES

Let fate do her worst; there are relics of joy,
Bright dreams of the past, which she cannot destroy;
Which come in the night-time of sorrow and care,
And bring back the features that joy used to wear.
Long, long be my heart with such memories filled!
Like the vase in which roses have once been distilled.
You may break, you may shatter the vase, if you will,
But the scent of the roses will hang round it still.

THOMAS MOORE.

BEFORE discussing various phases of memory, or memories, we shall redeem the promise made at the close of the last chapter to illustrate the working of our hypothesis, genetic parallelism and functional interaction. We shall assume that every perception and its feebler repetition involved in recollection is a dual process into which conscious and physical elements invariably enter; that every psychical process is accompanied by a corresponding neural process; that either may take the initiative in recalling an experience, and that one having once induced the other to a certain act, the two unite in its performance; that there is a functional interaction. In the words of Browning, "Nor soul helps

flesh more now than flesh helps soul." I conceive that an image may be revived in two ways: (1) The neural discharge, by virtue of the brain modifications caused by the original perception and previous recall, may take the initiative and, together with the conscious stream which has accompanied the discharge in the previous processes, may lead to the recall of the fact or experience. (2) The conscious element may take the initiative and, accompanied by the neural impulses with which it previously has been associated, may become responsible for the recall. It is by no means necessary to assume a different process for conscious, subconscious, and unconscious states; for what is unconscious to-day may become conscious to-morrow. The mental life is one. We assume not only split-off consciousness of the cortical states (which was amply illustrated in Chapter III), but also that wherever consciousness exists in man, there is a neural counterpart; and wherever there is a portion of the living neural mechanism, there consciousness exists, although the latter may seldom report its doings to the focus of consciousness. Reference was made in the previous chapter to the view of Pflüger and Lewes. Fechner holds that the entire body is the seat of the soul. Recollecting that only from one to six images can be in the focus of consciousness at a time, perhaps we can explain the exceeding complexity of the nervous and mental mechan-

ism by assuming that processes like the cortical in kind, but not in degree, exist throughout the nervous system. If the reader believes that the mental and physical phenomena are obverse sides of the same process, or that one is an emanation or aura from the other, yet for him the two phenomena practically exist. Perhaps the simplest type is represented by the reflex arc which is illustrated in Fig. 11. Let us sup-

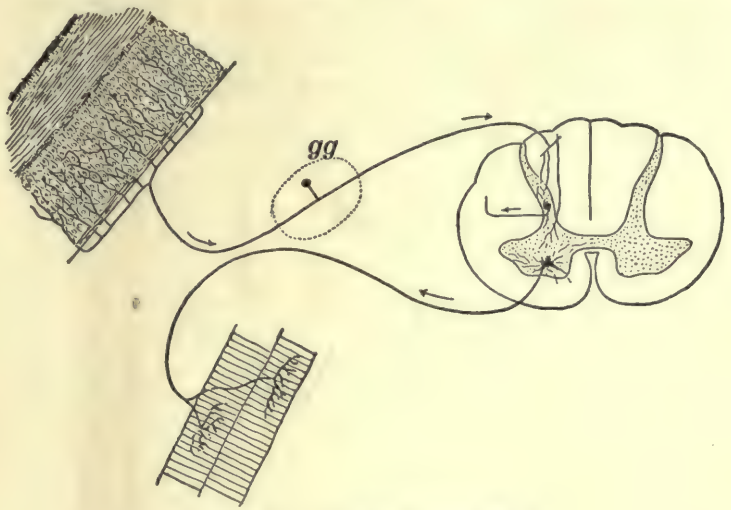

FIG. 11.—(*Van Gehuchten.*)

pose that the neural process takes the initiative and, accompanied by its conscious process, traverses the ganglion *gg*, and arrives at the sensory centre in the cord. Collaterals thrown out from this centre carry the excitation to the motor centres in the ventral horn by means of the terminal arborization. Here, again, the neural

impulses take the initiative and, accompanied by the conscious stream, arrive at the muscles in the lower terminus. We assumed, although not necessarily, that the neural element took the initiative. In the ventral or motor cells we may suppose that the same elements, both neural and conscious, respond to the excitations with which they have been *en rapport* in the past. If the act be secondary automatic, it represents the organic memory of Hering. If, however, it be a true reflex, it may represent an atavistic memory. In order to represent more graphically the interaction of the two elements the following diagram

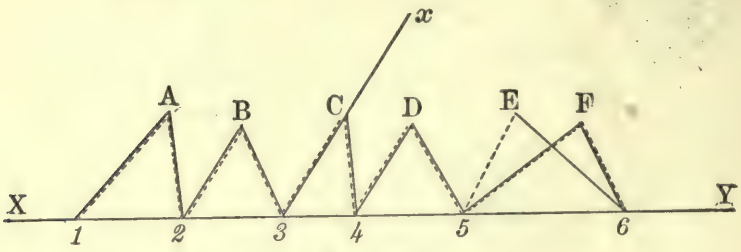

FIG. 12.

may be used. In the figure, let *A*, *B*, *C*, *D*, *E*, and *F* represent associated memories; let the heavy lines represent the path of the neural impulses, and the dotted lines the accompanying conscious stream. Let the excitation start at 1 and traverse 1*A*, accompanied by the conscious process with which it was associated when *A* was perceived. As the neural process 1*A* was the condition of the conscious perception of *A*, so

it is a condition of its conscious recall. In this case the nerve impulses took the initiative. The recall of *A* differs from the perception in that it is not quite so vivid, and the conscious element reports to the focus of consciousness or to the personality that *A* is familiar and has been perceived before. We must remember that the gray matter of the cortex is in a state of unstable equilibrium and has a tendency to discharge in all directions, but is controlled in a large measure by habit and follows well-worn paths. The conscious element, too, is on the *qui vive* in memory, and when the mental excitement is greatest the most memories are revived. The nerve impulses now traverse the paths *A*2, 2*B*, or they may short-circuit from *A* to *B* accompanied by the conscious stream. So *A* recalls *B*, and in like manner *B* recalls *C*. So far the neural impulses have taken the initiative in the act of recall. At *C* let us suppose two equally well-worn paths for the nerve impulse, *Cx* and *C*4. The shifting neural chain is as liable to go in one direction as the other. But the conscious element may have a preference for *C*4. Perhaps there is a dim realization that something like *D* will turn up by the route *C*4. Here the conscious element takes the initiative and the route C4, 4*D* is traversed. In like manner *D*5 is traversed. Now, suppose that when 5 is reached there is no path for the neural element from 5 to *E*, but that there is a well-worn one from 5 to *F*. Either

F is recalled, or consciousness, feeling that there may be something here, may take the initiative and, becoming accompanied by a new neural process, 5*E*, which is not here represented, reaches *E*. The feeling comes, I know it is here. *F*, however, as already noted, may be recalled directly and *E* be "forgotten"; or *F*6 may be traversed and the neural element 6*E* become accompanied by the conscious stream 6*E*, which is not represented in the figure, and reach *E*. It is assumed that neither the conscious current 5*E* nor the neural element 6*E* is efficient in itself to recall. The two elements work together "like perfect music set to noble words." If the process represented above take place in the lower level, and there be no discomfort associated with the recall the act for long intervals may not be reported to the cortex, nor become a part of our conscious experience. That there is a minimum amount of consciousness may be inferred from the fact that if the process does not work well, owing to fatigue or disease, the difficulty becomes reported to the focus of consciousness. Several representations of Sollier have been adapted to illustrate our hypothesis. Although they are arbitrary and do not claim to represent neurology, they will serve to make clear our meaning.

These movements do not invariably occur singly. They may react upon one another to produce a series of associated movements.

Fig. 13 represents a series of movements which are associated in a definite order. Let AX be the path which the excitation is to take, and Bm, $B'm'$, etc., be corresponding movements to which the traversing impulses give rise in the nerve-centres B, B', B''. (Fig. 13.[1]) The neural im-

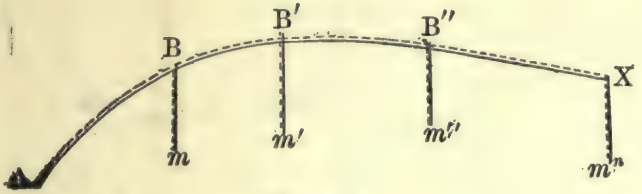

FIG. 13.

pulses, accompanied by their conscious correlate, start at A; as soon as B is reached the movement Bm arises, and at the same time an activity is created in B' which gives rise to $B'm'$ and B'' is aroused. We may, on the other hand, conceive the conscious stream as taking the initiative, and the process may take the same course or the reverse. Possibly a feeling of discomfort at B'' leads us to ask what is the matter. Perhaps the race or the individual may have learned in the past that when B'' was affected, assistance was gained from B' or B. Here consciousness takes the initiative and, accompanied by the neural chain of impulses, starts from B'' toward

[1] This and the following figures are borrowed from "Les Troubles de la Mémoire," by Dr. Paul Sollier.

B' and B. It is simply a call upon benevolent neighbours. Again, the process, initiated either neurally or consciously, may have more than one path from which to choose. In Fig. 14 let A be the point of departure of the neural

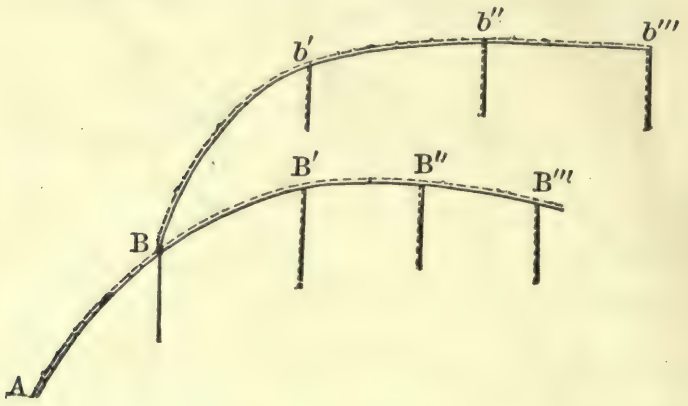

FIG. 14.

excitation. When B is reached the streams have two paths from which to choose. It may be, however, that the route $BB'B''B'''$ has been more frequently used, and that in consequence the neural path BB''' has become better worn and embedded. Then, too, the conscious stream has been more in the habit of traversing this route. The result is, the lower path is taken and the reaction BB''' takes place. Again, the conscious element may take the initiative, and, accompanied by the appropriate nerve impulses, follow the less frequented and more difficult route. More effort is expended, and there re-

sults the reaction indicated by the upper route. Here the willed reaction takes the precedence and the more difficult task is performed, a task, however, which will never be so difficult again; for the matter is better disposed, the molecules are rearranged, and the path in the nerve substance is worn deeper. If one were to take exceptions to this indeterminism and raise objections to the assumed freedom of the will, still the psychological explanation of the process would stand. All the difference would be that in the place of the freedom to choose on the part of consciousness, and the fiat, the stronger motive would be followed, and by it the upper route would be determined.

Two courses, initiated either by the conscious or the neural element, may have only a single

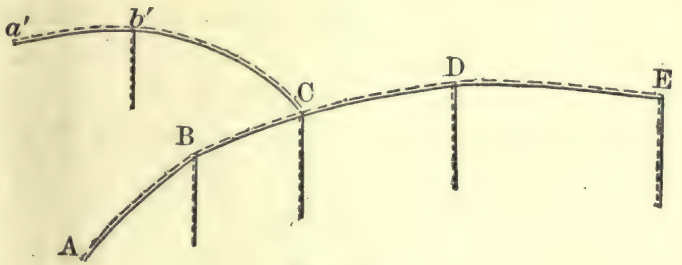

FIG. 15.

path open to them, and this path, the one of least resistance, is liable to be traversed, for we are creatures of habit. In Fig. 15 let *ABC* and *a'b'C* be courses along which impulses are passing. When they reach *C* they will probably

take the route *CDE*, and the elements, both conscious and neural, will be reinforced. If, however, *a'b'C* has been united at times with *ABC*, and, reaching *C*, first turns to take the route *CBA*, the movement is inhibited. If, on the other hand, a series of neural impulses, accompanied by their conscious counterparts, were to arise at *E*, upon reaching *C* each of the elements might divide and become diffused. It is probably in this way that conscious and neural elements become weakened and lost. Here we see the force of habit. Such processes explain motor automatisms. A man puts his bills under his hat for safekeeping, stops to chat with a friend, and, as usual, takes off his hat to scratch his head. The money is lost, but the reaction is more firmly established. It matters not whether these acts be reflex or whether they take place in full consciousness, the explanation is the same. To repeat: The mental life is a living whole. We attend to from one to six things at a time. The greater part of our mental life at a given time does not, at least for the present, influence our conscious life. It is well for us that this is so, for otherwise life would become a burden. We become efficient in direct proportion as we are able to entrust acts to the direction of the lower centres and thus relegate them to the realm of the subconscious and the unconscious.

Sollier represents the psychical memory of a word by a circle. In Fig. 16 let the motor

articulate image be M, and let W be the motor image of writing; let S represent the sensory image of its general character, and let A represent its sensory image of sound. Any of the images will call up the one on either side of it and consequently reinstate the whole. It matters neither where nor how the recall is initiated.

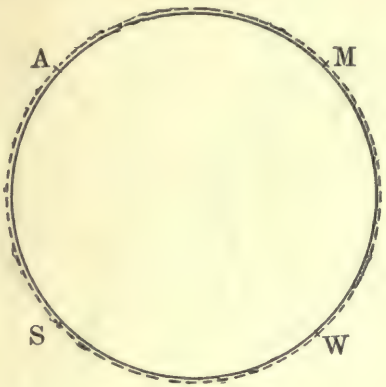

FIG. 16.

In the case of a person talking to himself the neural element, probably, often takes the initiative, and the excitation may usually begin at A. At least A is the strongest and prevailing image. Yet the conscious element may begin the act of recall, for, as Mach says, absent-mindedness is really present-mindedness. All thought is incipient motion. The conscious and neural elements may radiate from one image toward each of the others, as is illustrated in Fig. 17, or toward a common centre, as is illustrated in Fig. 18. In Fig 17, if the various word-images were

equally used, it would almost be a matter of chance which took the initiative. Here *E* represents a second image of general characteristic. In Fig. 18, *FC* represents the focus of consciousness. But I do not think, as does Sollier, that the images *M*, *W*, *S*, *A*, and *E* are grouped into a bundle, and that *FC* represents this bundle. Wundt has shown that a similar conception of

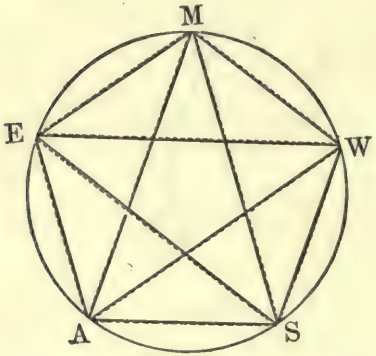

FIG. 17.

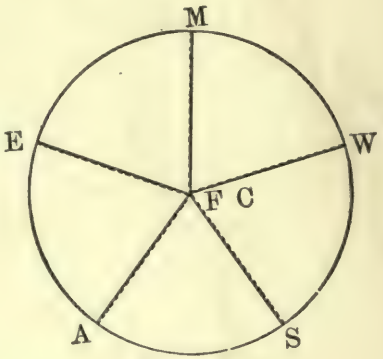

FIG. 18.

Hume is inconceivable from a psychological point of view. It may chance that one of the images has a stronger affinity for another image than for any of the images in the word considered. This may be illustrated by tangent circles. (Fig. 19.) By reason of vividness, frequency, or recency *M* may have a stronger affinity for *W'* than for *W* or *E*. In this case the word *W'S'A'E'* is recalled instead of that represented by the images *W*, *S*, *A*, and *E*.

The focus of consciousness, its blaze and glare as it were, is a superadded phenomenon,

i.e., the memory is a memory without it. But a slight degree of conscious activity may accompany each individual or racial memory, no matter how far it may be from the threshold of consciousness. The conscious personality

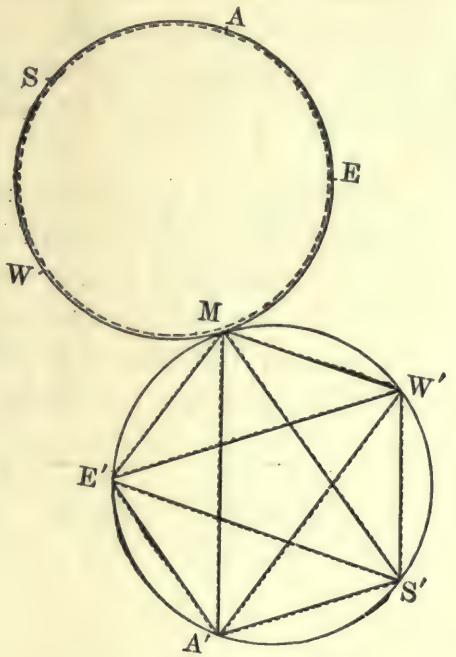

FIG. 19.

holds the same attitude toward it that it does toward the minister in the pulpit. If he be a stranger, or anything goes wrong, it watches him; but if he be the regular clergyman, and it is certain that all will go right, it takes less notice of him or is lulled into sleep. "An impression in the sensory memory will not be

brought before the consciousness if its psychical intensity does not reach a definite standard."[2] In the case of the secondary automatic memories, so long as the working goes on smoothly we never attend to them. Life is too short, our mental equipment is too limited, and consciousness becomes too soon fatigued. Paradoxical as it may seem, the man is more efficient in proportion as he approximates the condition of an automaton.

In order to recognize a memory as our own we do not need to locate it between two others. It is sufficient to place it in a group of past experiences. This gives us the feeling of familiarity which assures us that the experience is our own. Upon the line of experience *XY*

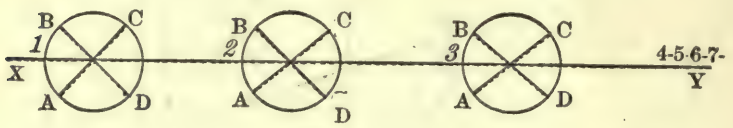

FIG. 20.

(Fig. 20), let 1, 2, . . . 7 be memories. In order to locate 2, it is not necessary to locate it between 1 and 3; it will probably suffice to place it between 1 and 6. (It will not be possible to locate it between 1 and 3 or 1 and 6 unless either 1, 3, or 6 be a time datum.) The mother may not be able to locate an event before or after

[2] Edridge-Green, "Memory: Its Logical Relation and Cultivation."

her child could walk, but if she knows that it occurred while he was a baby, she recognizes it. Fig. 21 represents diverging associations. *A*

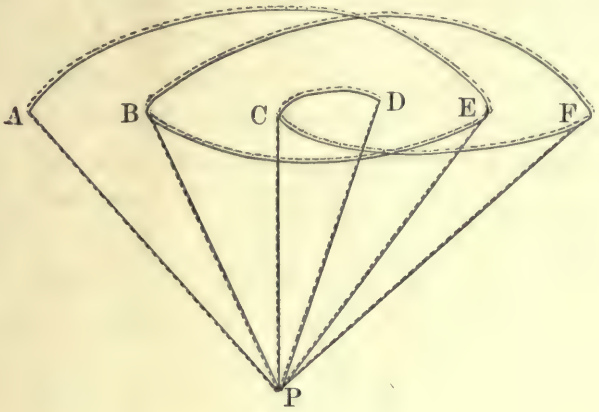

FIG. 21.

suggests *E*, *E* suggests *B*, *B* suggests *F*, *F* awakens *C*, and *C* awakens *D*. Fig. 22 represents

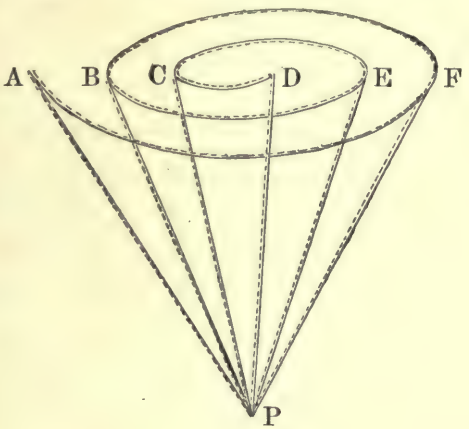

FIG. 22.

converging associations, and the order is *AF*, *FB*, *BE*, *EC*, *CD*. Sollier represents these mem-

ories, which he terms dynamic associations, as coalescing at times. This may seldom happen. Each molecular or conscious change may vary in degree, in direction, or in the associations in which it participates. There is no sufficient reason for their being alike. The law of parsimony and the law of inertia are too regnant in the nerve matter. Our experiences, like our personalities, are ever changing. However beaten the paths, however strong the neural or conscious habit, each experience may differ. In Fig. 23 let *T*, *M*, *V*, and *A* represent tactile,

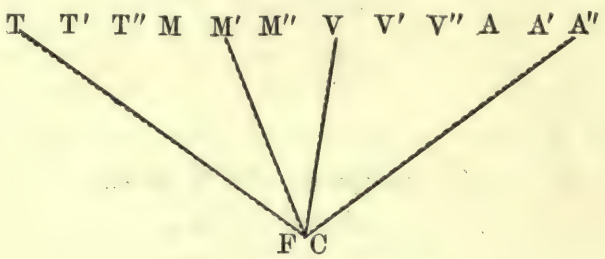

FIG. 23.

motor, visual, and auditory images; let *FC* represent the focus of consciousness; let *T*, *M'*, *V*, and *A''* be in connection with *FC*. They are thought of and become part of our mental life, but *T'*, *T''*, *M*, *M''*, *V'*, *V''*, *A*, and *A'* do not, for the time being, exist for us so long as we do not call them up. As they do not modify our consciousness, they might as well not exist. In this way we may account for temporary amnesia. The following figure represents these processes, all entering into the focus of consciousness.

This may often happen when the person is young and in health. (Fig. 24.) We are con-

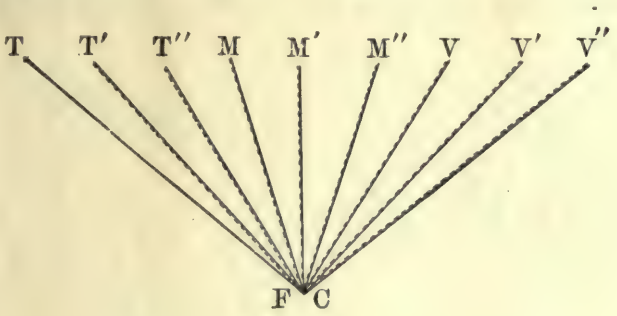

FIG. 24.

scious of few memory images when extremely fatigued. Part of the images of a word or idea may be wanting. The process of recall is hindered. In paralysis or other forms of cerebral disease, as we have seen, amnesia may become quite permanent. This happens in the case of logical memories when we cannot recall nice discriminations. It may occur because we did not attend to the perception or because we have not recalled it since. One reason why the memory of the aged is so good for early experiences is that they have recalled these facts many times. In Chapter III examples of alternating personality were given and reasons were assigned for the explanation of the phenomena. In several instances both primary and secondary states were pronounced. By analysis we found that the case resolved itself, in part at least, into one of the states of association in a definite period

of the past. In order to understand better this phenomenon we may use the following diagram. Let *A*, *B*, *C*, *D*, *E*, *F*, *G*, *H*, etc. (Fig. 25), rep-

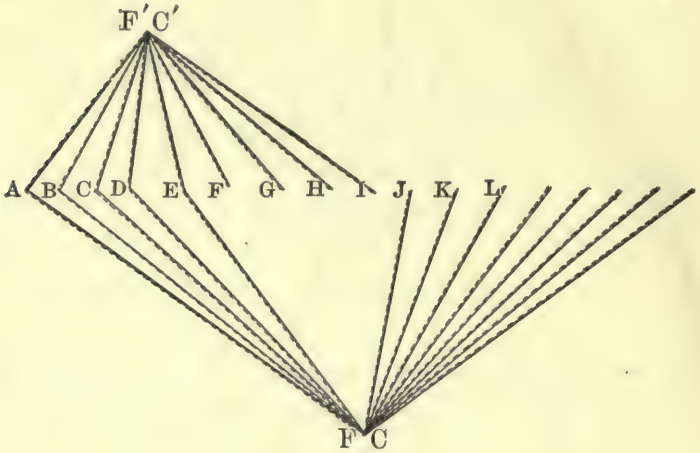

FIG. 25.

resent memories. If all of these memories centre at *FC*, we have the normal state. There is one focus of consciousness, or personality. Now suppose that *F*, *G*, *H*, and *I* do not focus at *FC*. They may unite with *A*, *B*, *C*, *D*, and *E* at *F′C′*. Here *A*, *B*, *C*, *D*, and *E* represent fundamental elements in the personal life. *F′C′* now becomes a secondary focus of consciousness, or, for the time, a secondary personality. Here, the primary and secondary states are mediated by *A*, *B*, *C*, *D*, and *E*, elements common to both. The secondary state may claim a larger share of the memories than are here represented. This schema also illustrates how our personality develops. The following representation illustrates

more definitely alterations of personality. In view of the previous explanation, this figure explains itself. (Fig. 26.) *AB* represents both per-

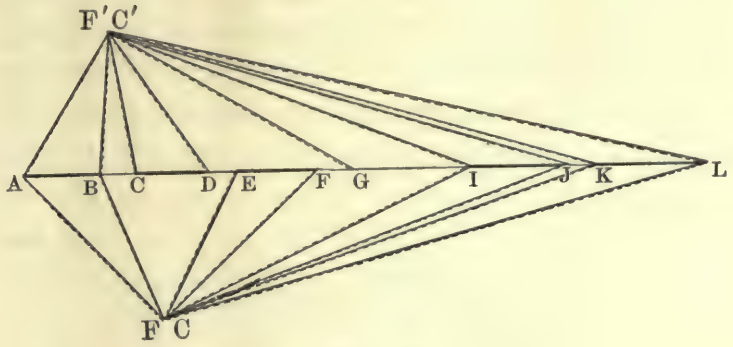

FIG. 26.

sonalities; *BC* and *CD*, the second personality; *EF*, the first; *GI*, the second; *IJ* is common to both, etc. A series of alternations occur, according as *AB* or *BC* is functioning. A single other illustration is taken because it represents well the visual type of memory to which most people belong. (Fig. 27.) Sollier represents the visual image of the word by *V*, the auditory by *A*, the graphic by *G*, and the motor image by *M*. Whatever image may be excited, *V* is sure to awaken first, and is of course regnant in calling up the word; furthermore, *V* may be so large that if destroyed by disease, the others would be incapable in themselves of recalling the word. The schematic outline here used is not to be regarded in the least as illustrating the neural mechanism. It is wholly mechanical, and

is simply employed to make an abstract subject concrete.

Fauth supposes that the feelings play a large part in reminiscence, particularly the æsthetic feeling for the beauty of the whole. We are, he states, dissatisfied with a partial recall because of its fragmentary nature and a sense of fitness, or of the propriety and the beauty of the

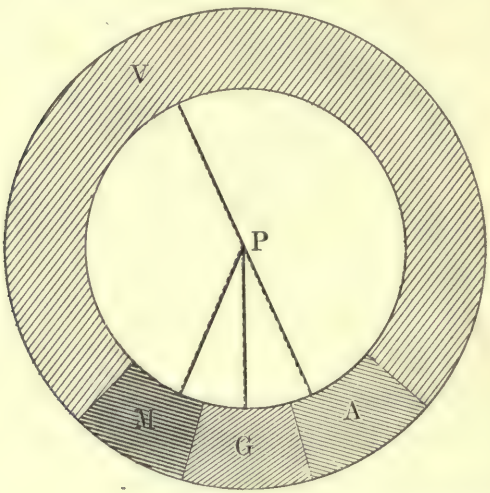

FIG. 27.

whole stimulates us to complete the memory. It is probably true that the feelings play a leading rôle. While the affective state as such cannot be revived without its intellectual substrate,[3] many memories apparently originate in our cœnesthesis or general bodily feelings and emotions. "Sir Walter Scott recognized the

[3] Professor E. B. Titchener, *Philosophical Review*, vol. iv.

power of emotion in reviving pictures when he made Sir George . . . recall, after years of absence, and in a moment of excitement, 'the grindstone' and 'the white rock in line with the steeple.' 'I think Your Honour kens the bay as weel as me,' was the emphatic response to the accuracy with which Sir George's brain reacts when restored to the scene of his youthful follies and crimes."[4] Several theories are put forth to account for feelings. Whatever one may be adopted, the feelings undoubtedly have their physical accompaniments and may conform to our general hypothesis.

We must carefully distinguish between analogies to memories and real memories. By analogy, we may state that when man had forgotten, if he ever knew, the complete record of the successive ages, a permanent mnemonic was disclosed to the geologist in the rocks of different periods. Each age held her memories of vegetable and animal life, of upheaval and convulsion. Fossils over which the ages had been keeping guard were revealed to him who by patient study might "think God's thoughts after him." The beauty of Trenton Falls and the grandeur of Niagara recall the work of the West Canada Creek and of the Niagara River. The paths in the nerve-tissue find their analogy in valleys made by erosion and in water-sculp-

[4] Cited by E. H. Clark, M.D., "Visions."

tured rocks. Drummond refers to the brain as an elevated table-land containing roads and travellers upon them.[5] The branches and trunks of trees and the blossoms of the plant may be considered as so many memories of leaves. The human body, containing more than one hundred rudimentary and now useless organs, recalls the manner of its development, while the various stages of fœtal life are now regarded as memory images of the successive stages of racial unfolding. Such are some of the many analogies. The organic memory which is sanctioned by many eminent representative psychologists has already been discussed. In Chapter II a large number of examples were given to illustrate this view. If the germ repeats what was acquired during life, much more does it represent what has been inherited for generations. We saw also in Chapter II that the term atavistic memories is frequently used by writers whose standing renders it presumptuous for us to ignore their statements. To some of these writers reference has already been made. We may further quote from Sully: "May it not happen that, by the law of hereditary transmission, which is now being applied to mental as well as bodily phenomena, ancestral experiences will now and then reflect themselves in our mental life and so give rise to apparently personal recollections? No one can

[5] "Ascent of Man."

say that this is not so. When the infant first steadies his eye on the human face it may, for aught we know, experience a feeling akin to that described above, when through a survival of dream fancy we take some new scene to be already familiar." [6] Marie de Manacéine maintains that we have atavistic dreams in which experiences which were common to distant ancestors are revived. "As soon as man's personal consciousness is lulled and consequently inactive, all the tendencies transmitted by the farthest ancestors which were latent in his waking hours now begin to revive. . . . A good man may awaken in horror with his forehead bathed in sweat from a dream in which he was transported into some strange and antipathetic environment in which he had committed a barbarous and cruel deed, not altogether abnormal, but wholly possible in the far past of humanity. . . . In the presence of such, Maudsley may well exclaim, 'If we were held responsible for our dreams, there is no living man who would not deserve to be hanged.'" [7] When the hands of the infant are put in a certain position it makes movements as if trying to swim. The swaying and oscillating movements of the human body have been referred to similar movements of the ancestral fish. Fear of large eyes is very common with children and may be

[6] "Illusions," p. 280.
[7] "Sleep: Its Psychology, etc."

atavistic. The conception of atavistic memories is used by popular or *quasi*-scientific writers. Le Bon believes that the mob is atavistic and that it bases its action upon inherited impulses. It takes no great stretch of imagination to conceive that we are such stuff as memories are made of, and that there are rudimentary organs of the soul as well as of the body which recall much of the racial experience since, and perhaps before, the first moner divided. It will help us to adjust our notions to the plural form if we bear in mind that the singular form of the term memory was applied to all the memory processes when neurology was a *terra incognita* and the soul was divided into water-tight compartments, or faculties, one of which was memory. A book which has just come to my desk, entitled " Memory and Its Cultivation," by Mr. Edridge-Green, bears striking evidence that with very conservative psychologists the richer content of the term, acquired largely from sources of evolution, has burst the primeval singular form. This author holds to the old designation of mental faculties, but under the heading " The Special Memories " he designates thirty-seven different faculties. Certainly, to continue holding to the singular form in the light of current investigation and literature savours of ancestor worship.

The muscular memories depend chiefly upon the nervous system, and the pure muscular mem-

ory is slight. By exercise a muscle acquires new power, which is due in part to a change in the muscles themselves, but such memories are associated with the nervous system. This is possible because the motor nerve terminates in the centre of the muscles and throws off branches in all directions. There is a certain facility gained which may be termed a muscular memory in speech memories, for speech is a form of gesture. First, there is the sensory image of what is to be recalled; second, the motor image; and finally, the articulate or lowest form of speech memory. It consists of the facility gained and habit acquired by speaking the word. In paralysis, which is a form of amnesia, the articulate memory may disappear altogether. But it is to be borne in mind that the articulate memory appears chiefly in connection with the terminal nerve branches in the muscles. Ribot has emphasized the secondary automatic memory. In discussing secondary automatic acts we must bear in mind that either consciousness split off from the cortical sensory centres presides over these acts, or, as I have previously assumed, consciousness, like the cortical consciousness in kind, though in faint degree, attends all neural action. "As these [the two hemispheres] owe their intelligence to the consciousness which we know to be there, so the intelligence of the spinal cord's acts must really be due to the invisible

presence of consciousness in a lower degree."[8] A spinal cord which "cannot remember is an idiotic spinal cord." We must remember that "unconscious cerebration" plays a leading rôle in the mental life. Herbart and his school have accepted the unconscious mental processes. Psycho-physical experiments show that the conscious span is limited. It is not strange that many memories remain dormant for a long period, memories which, obedient to some stimuli, finally arise and pass over the threshold into the focus of consciousness. The secondary automatic movements presided over by the first and second levels, after becoming fully acquired, seldom function with the highest level. Such actions are walking, playing musical instruments, and writing. When the child begins to walk, each step is a conscious process, but later each one unconsciously suggests the next, and he arrives at his destination without a conscious thought of how he came. When the child learns to write he constantly changes his position, moves his feet and limbs, and it is apparently as necessary for him to let his tongue hang out of his mouth as it is to hold his pen, but later he becomes quite unconscious of his movements and pays little more attention to the process than to his manner of climbing the stairs. The skilled

[8] Argument by Pflüger and Lewes, cited by James, vol. i., p. 134.

musician pays no attention to movements which are consciously painful for the beginner. Usually the transition from the conscious state to the remembered, automatic one is gradual and acquired with difficulty. Ribot cites a case in which he says this transition was immediate: a player in the orchestra, suddenly deprived of consciousness, played on without missing a note. Ribot assumes that he had attended to the act of playing immediately before becoming unconscious. It is, however, difficult to state just how sudden the transition was. In our Civil War, cavalry riders and foot-soldiers frequently slept while they rode or marched. He who has played tennis and after an interval of several years resumes the play finds that his hands and arms retain a certain facility in serving. One who had not skated for many years put on his skates and glided along quite easily and safely. Robert Houdin was enabled by practice to keep four balls in the air at a time. After an interval of thirty years, without once having tried, he found that he could keep, without difficulty, three in the air. There are dormant memories, and it seems as if, at times, the hands and feet recall, as well as the cortex functions. It is related of Canon Gore that he was once present at the death of a pickpocket who professed penitence. In the agony of death, the dying man exclaimed in a hoarse whisper, "Look out for your watch!" While uttering

these words he died, but his hands held the good Canon's watch. The hands remembered their old habits, and the enfeebled will could not resist. A case in point is that of the man who forgot his watch and drew it out of his pocket to see if he had time to go back and get it. Drs. Breuer and Freud state[9] that a young woman heard a statement which caused mental anguish. Suddenly her wrist dropped helpless by her side. Years afterward, when she had forgotten about the incident, the wrist still occasionally would drop as if it recalled the experience. Charles S. Kinney, M.D., of Middletown, N. Y., to whom I am deeply indebted, furnished the two following illustrations. No. ——, age 28, had acute dementia; for several weeks he sat, with head bowed upon his chest, indifferent to his surroundings. His face was pale; his hands and feet were cold. Without any known occasion he began to go through the motions of an expert weaver; he threw the shuttle, tied up broken threads, and examined his work. At the same time he continued indifferent to his surroundings and paid no attention to any one who approached or addressed him. He continued this work in the same position on the floor each day for a number of months. He gradually assumed a composed manner, came to a knowledge of his surroundings, and acquired good self-control. He said

[9] "Studien über Hysterie."

that he had been a weaver years before, but had no distinct memory of his life while in the hospital. The retrograde amnesia disappeared, but the anterograde remained. He recalled his early life, but the time from his sickness on remained a blank. Another patient who had almost lost his faculties made all the motions of sewing. He was undoubtedly a tailor, but never revived to tell of his past life. These illustrations show how abiding is the motor memory. What the hands and feet have once done they do not easily forget. These examples, which might be multiplied indefinitely, explain the reasons for calling the secondary automatic acts memories. In the last case this was the only memory which the patient manifested. In the previous instance the secondary automatic was the more abiding memory, and the sole recollection for a long period. All of the examples show the tenacity of these acquisitions which belong to the very self of selves. Pure reflex acts, so far as they have become acquired organic habits, have been termed memories. The motor memory refers to those reflex acts which were formerly voluntary. It is a modification of nerve-centres concerned in voluntary movements, and is due to coördinated muscular movements and also to the habit of estimating the amount of innervation necessary to excite the movement. Miss Theodate Smith found that the motor memory plays an important part in the case of nor-

mal persons.[10] Steiner's experiments showed that what I may term memory exists in the spinal cord. He found that the headless body of a shark would swim the entire length of an aquarium, stopped only by the side of the wall; then, when turned about, would swim back to the place from which it started.[11] The inherited reflexes are, as already intimated, atavistic memories.

In all motor memories there appear to be three stages of integration. The first consists of nearly all stimulus and very little reaction. In the second the stimulus decreases and the reaction increases. In the third a very slight stimulus discharges the whole motor apparatus.

Turning to the sensory memories we find a rich profusion of images mediated by the sensory nerves. A class of memories, chiefly sensory, with which all are more or less acquainted are the topographical memories.

"Sweet scenes of youth, to faithful memory dear,

. . . . . .

Sweet scenes of youthful bliss, unknown to fame!
I come to trace your soothing haunts again,
To mark each grace that pleased my stripling prime,
By absence hallowed, and endeared by time."

JOHN LEYDEN.

President G. Stanley Hall revisited four farms upon which he had lived at different times in

[10] *American Journal of Psychology*, vol. vii.
[11] *Ibid.*, vol. iii.

childhood. Upon the first farm he resided until two and one-half years of age, and revisited it for the first time after an interval of forty-seven years. A swamp gave him a vague feeling of familiarity; a knoll suggested, " Hello! why yes, of course, there was something like that "; the rocky end of a knoll suggested cows, and upon inquiry he learned that this place many years before had been used as a cow-yard; the smell of catnip, a gloomy wall, and some mosses revived similar dim impressions of familiarity. But this farm yielded only one definite conscious memory. The object recalled was an old wheel with a spout attached through which water could be poured.

He resided upon the second farm from the age of two and one-half until he was twelve and one-half years old; since leaving he had driven past a few times; here 700 memories were revived, of which more than 400 had been in his mind at some time since. The other farms revived a rich profusion of images. Many of these memories were peculiar to the trained scientist.[12]

I took my mother to her early home where she had lived until six years of age and which she then for the first time revisited after an interval of seventy-seven years. We drove from the nearest railroad station to the little village among the hills. When within a mile of the vil-

[12] *Pedagogical Seminary*, December, 1899.

lage she expressed the feeling of familiarity. This feeling increased as we came to the village and stopped at the hotel which stands opposite the house in which she was born. Both buildings have remained unchanged, except by the elements, since she left. Her first impressions were thus stated: "Is this the place? Well, it seems to me as if— I can't say for certain." Upon entering the old home, she recalled the general appearance of the front room where her father kept his store. She recalled vividly where the candy and raisins had been kept. The kitchen seemed familiar, and she recalled what her mother said at one time while kneading bread in the pantry. Later she found her sleeping-chamber and recalled where the head of the bed was. From this vantage-ground memories of the old hotel came back vividly. The well, the old schoolhouse, and another house were located. The schoolhouse revived other memories. An aged man informed me that these two buildings, her home, and the hotel were probably the only buildings in the town when she lived there. Her memories awaked emotions of pleasure, and it seemed a hallowed day.

In the recall of topographical memories, as in the case of organic memory, there are apparently a few well-defined stages: there is a feeling of familiarity, very vague at the beginning, the "Hello!" and "It seems to me that." The second stage is being aware of its existence. We

are conscious that it is here. The third stage is that of incomplete knowledge. We have the thing itself, but must add to it. It is about to vanish. The fourth stage is the perception of the object. We see it clearly. In the fifth stage we have the conceptual memory. The object is gone and we think of it. The sixth stage is that of complete recall. These steps constitute the staging of memory. When the complete memory appears the staging is taken down as something which is no longer of service.

Visual memory is the fixation and recall of psychical images mediated by the visual brain tract described in the last chapter. The memory for form is mediated, in part at least, by particular muscles of the eye. If visual memories predominate over those of the other senses, the person is called " eye-minded." The visual stimuli usually make the strongest appeal to adults, except during sleep and repose. Green fields and trees, the blue sky, stars, flowers, the plumage of birds, grasses, and autumn tints alike furnish visual stimuli. They who have eyes, yet see not, will have few visual memories. Here belong the intuitive memories which are composed of mental representations independent of logical relations. Dr. Phillips found that about 75 per cent. of people have some means of visualizing number, and that one in eight have number forms. These forms are sometimes coloured. Binet observed

a girl who visualised most mental representations in coloured terms. As is well known, many chess and checker players play a good game while blindfolded. Binet holds that only the part of the board is visualized upon which the game is being played. Of course, as in actual vision, this part of the board is represented most clearly. In neither case do the peripheral parts of the board escape notice. The writer has to some extent practised playing checkers blindfolded, and represents the parts of the board which are peripheral to the location of the game proportionately as well as in vision. An opponent of Strickland who was celebrated for his blindfold playing presumed that the latter would be at a disadvantage in shifting his attention quickly to the opposite side of the board. Strickland had a single man on 21. His opponent, having a man on 9, suddenly moved 13–17 to find out whether Strickland would " see " it. It is needless to say that he " saw " it at once. The artist's memory is intuitive and exact. A painter may visualize a subject at one sitting. Form, proportion, and perspective are carefully noted. An artist, age 78, informs me that definite landscapes seen long ago come before her mind in reverie. Each stone, stump and tree, the curve of the shore, light and shadow, are recalled. She recalls very distinctly faces not seen for years. When any one or a combination of the senses

is appealed to, memories of other modalities may be suggested by association.

> "To me the meanest flower that blows can give
> Thoughts that do often lie too deep for tears."
>
> WORDSWORTH.

Our sensory memories are apt to be recalled in dreams, as well as in our waking hours. Jastrow has shown that those who do not become blind until the age of six dream in visual terms. What has been attended to by different senses immediately before retiring may modify our dreams. Professor W. S. Munroe states that the smell of cloves before retiring may modify dream images. Galton found that the power to visualize decreases with age.

Auditory memories are mediated by the auditory tract. They constitute the chief memories of the blind and of musicians. The auditory images may be coloured, and when coloured they are usually blue or red.[13] Instrumental music,

[13] Miss E. A., age 18, a college senior, associates with sounds sensations of colour, taste, and temperature. Seeing the word or letter written or printed does not suggest these sensations; the sound must be heard. The following groups of letters suggest the colour white, being named in the order of increasing whiteness: *ă*, *ā*, *ä*, *ą*, *k*, *y*, *h*, *i*, *j*, and *c*. *Ō* suggests dark blue or black; and *r* black. *U*, *w*, *m*, and *q* form an increasingly black series, but *q* is red in parquet. *E* suggests yellow, but sometimes red; *b*, *p*, *d*, *t*, *z*, *s*, *x*, and *l*, butter-colour. In the following letters changes occur: *c* may be butter-colour or white; *g* may be butter-colour, brick-red, or blue; *y* is white or blue.

the human voice, the murmuring, purling, and roar of waters, the rustling of leaves, the notes of birds, the hum of insects, and the voices of the night alike furnish stimuli. Indeed, we never escape auditory stimuli. During the hours of sleep the auditory tracts are affected, and undoubtedly dreams are thus caused and modified. In Binet's study of Diamandi and Inaudi he found that Inaudi, who has an auditory memory, can recall more quickly and a greater number of words if the series be short. On the other hand, if the series be long, Diamandi, whose memory is visual, can recall better than Inaudi. Dr. Hugo

Her favourite letters are *a*, *c*, *d*, *i*, *j*, *k*, *l*, *q*, *t*, *u*, *v*, and *y*. The following letters are disliked: *f*, *g*, *h*, *o*, *p*, *s*, *x*, and *z*. The indifferent letters are *b*, *e*, *m*, *n*, *w*, and possibly *r*. These preferences are based upon the sound of the letter or upon its name. "I like these letters, i.e., the favourite letters, because they make a pleasant sound; I like the name of *f*, but not its sound."

When the letters are combined into words neither the meaning of the word nor emotional like or dislike seems to give colouring to the word; e.g., green sounds red; red, yellow and white; black, white; God, black; Jesus, yellow; Judas, black and white; painting, white and green; colouring, black and green. The examination of a large number of words apparently indicates that while the sound-colourings of the different letters are sometimes blended into one or two colours, more frequently one or possibly two striking letters attract her attention and, becoming regnant, determine the colour of the word.

The pitch of all musical tones is a bluish-green, dark, almost black in the lowest bass notes, and shading by regular gradations to a very light tint in the highest treble.

Münsterberg, after experimenting upon the visual and auditory memories, concludes: "With all subjects the visual memory excels strongly the auditory memory when they act independently. When the two senses act together in memory they hinder each other; . . . when isolated the visual excels the auditory; when combined the auditory excels the visual. A series of presentations offered to two senses at the same time is much more easily reproduced than if given only to sight or only to hearing."[14] We have seen that the memory of a word is not simple, but

Coloured associations do not aid her in memorizing paradigms. The colour of the word is not affected by her mood. She first noticed the tendency to associate colour with sound when she was about eight years of age. Although all sounds still seem to be coloured, she believes that the tendency has slightly decreased as she has grown older. It had never occurred to her that these colour associations were at all unusual, and previous to the study of psychology she had supposed that all persons had similar experiences. She is not conscious of these associations when listening to music or conversation, because her attention is centred upon the interpretation and thought and not chiefly upon the sound.

With sounds of letters are also associated sensations of taste and temperature. The tastes do not include sweet, sour, etc., but only insipidity and saltness. Some have neither taste but are indifferent. The letter *r*, which she classes as indifferent or disliked, has a strong salty taste; most of her favourite letters are insipid. In temperature *r* is the warmest, about as warm as she could bear in her mouth; *ĕ* is the coolest, being about 60°.

[14] *Psychological Review*, vol. i., pp. 34-38.

is made up of sensory images—visual and auditory—and of motor images—phonetic and graphic. Persons who can neither read nor write have only the sensory images. Each individual gives preference to one of these images, and this constitutes his memory type. This type is determined by hereditary and acquired disposition. The best type is probably that which is a synthesis of all the different memories. Children under 12 years of age frequently belong to the auditory class.

It is quite possible that the olfactory memory plays a larger rôle than we have been accustomed to believe. In Chapter II I alluded to a conviction sustained by Waldstein's investigation that the subconscious plays an important part in our mental life. Waldstein, alluding to the fact that as a minimum, $^{1}/_{920000}$ milligramme of chlorphenol (and a much less amount of another substance) in a cubic centimetre of air is perceived by the human sense of smell, inquires: Is it not through this sense that our subconscious emotional life is principally affected, and is it not fair to assume that olfactory and tactile sensations are largely accountable for our moods? Odour images of the trillium, the daisy, barks, mosses, crinkleroot, ginseng, peppermint, spearmint, and orchard blossoms constitute part of the olfactory memories of every country child and of the many city children who once a year at least are given an opportunity to live and be-

come educated in the open air, among green pastures and rich meadows.

The gustatory memory, though more obscure than the olfactory, in one case, at least, is well developed for mints and certain roots, eaten little since childhood's days. The tactile memory is memory for sensory impressions produced by active and passive touch. Deaf-mutes are of the tactile, or rather the motor-tactile type. The blind are tactile, and can distinguish garments by their texture, though sometimes they are aided by the odour. Stetson found that one junior in a class of one hundred belonged to the tactile type. His dreams were of a tactile nature. I am informed that typewriters when blindfolded have written forty or forty-five words per minute. Helen Keller appreciates music by feeling the vibrations of the instruments with her fingers lightly placed upon them, and even appreciates vibrations from the floor when it is covered with a thick carpet. When her fingers are placed upon the throat of a singer, she interprets music well.[15] Laura Bridgman so improved her sense of touch as to recognize, after a year's interval, the hand of a person who had once shaken her own.[16]

Closely related to the topographical memories is the verbal or mechanical memory. It concerns itself with the form, and there is a strong tend-

[15] Waldstein. [16] James.

ency to locate the words topographically. We try to go through the same process that we did in acquiring the knowledge of the words or sentences. The student recalls upon what page and what part of the page in the dictionary the difficult word is found. This memory has its place. Passages of Scripture, poems, and fine passages of prose, when carefully memorized, furnish the mind with materials, create a literary taste, give facility and felicity of speech, and wealth and beauty of expression. The linguist attends to nice discriminations between terms, to distinctions of voice, mode, and tense, in order to ascertain the exact meaning of the passage. He sees shades of meaning, an orderly succession of thoughts, and a harmony of the whole which escape the careless reader. It is far from true that in proportion as one attends to the form of the passage he loses the thought. Most words are crystallized history. The philosophy of Greece developed at the same time as the accurate, elegant, and finished language in which it was clothed. The Sophists made possible the thought of Socrates and his followers. They also developed the beautiful and flexible language found in the dialogues of Plato. The mechanical memory may be said to constitute the basis of the intellectual life.

The logical or judicial memory is the highest form of memory. It is a memory for consecutive reasoning, meaning, and thought. Substance is

more than form. From a perception of things related the mind passes to a perception of the relation of things. In this memory we cease to deal with the raw material. Comparisons are instituted. We notice similarity and differences, cause and effect, and whole and part. We pass to the logical memory when we ask the question Why? Wherever reason asserts her supremacy we have the logical memory in recall.

The memory which recalls readily has been termed the prompt memory. The facile memory consists of an easy fixation of what has been heard or read. The sure memory recalls with certainty. Here slow and sure are not synonymous.

The mathematical and scientific memories are distinct types according as the individual is a Gauss or a Spencer. The habit of making attainments in a given direction develops mnemonic power in the same direction.

All are specialists in memory. The modality of each individual differs. The genius whose memory is deficient for ordinary affairs is illustrated by the following lines:

"He can rattle off statistics of the tariff by the hour;
He can give you facts and figures of a grain crop in a shower;
He remembers to a second just the time each horse has made;
He can tell the score and outcome of each ball game ever played;

He can give you dates and data till you wish that you were dead—
But he never can remember to bring home a spool of thread."

Yet the highest genius may be characterized by a memory for small details. This type found its representative in Gladstone. The philosopher who walks down-town speculating as to whether the differential calculus is more indebted to Leibnitz or Newton, or considering what might have happened to evolution if Darwin's grandfather had not been of a scientific turn of mind, will have a different memory of his walk than the woman who, upon seeing a lady drive by, without looking at her, notices whether her hat is summer or autumn style, takes cognizance of every article of apparel, and can tell "whether the lace is machine or hand made." As each tree draws its peculiar nutriment from the earth in which it is rooted, so the soul makes its own memories from its environment.

"Oh, no! we never mention him, his name is never heard;
My lips are now forbid to speak that once familiar word;
From sport to sport they hurry me, to banish my regret;
And when they win a smile from me, they think that I forget."

THOMAS BAYLEY.

In a previous part of the chapter a portion of the schematic outline of memories and their working illustrated the process of forgetting. I find it impossible to separate the two subjects

Memory and Forgetting. They are too close'y linked. The following paradoxical expression takes us into the heart of the subject by a short route: we never forget and we are ever forgetting. The first thesis is—we never forget. In Chapter I we cited Maudsley to the effect that the bodily elements never forget an experience which they have once known, and that from secondary automatic movements we may infer that we never absolutely forget anything which we have experienced. We saw that Draper held that the brain-tissue might be permanently modified. Professor Ladd, as we remember, holds that the nerve tissue never forgets in entirety an impression once made upon it. It is not too much to state that every sense impression or motor response leaves its traces somewhere. Rip Van Winkle may not count the drink this time, but nevertheless it is counted down among his nerve-cells.[17] Even what we perceive in the peripheral field of vision at least modifies the content of the central field. On the psychical side every mental attainment and every thought leaves its impress. The conscious stream is changed by every tiny rill which acts as tributary or drainage, and so far as we can judge remains changed forever. Every hour we weave the warp of the future and spin destiny. As already seen, we elect the self into which we are to grow and not a layer

[17] Professor James.

of experience is lost. In the light of our discussion upon hypermnesia, in Chapter II, who shall say that we do not retain all experiences and may not be able some day to recall them? Lady Macbeth cannot forget the memories which curse her. " All the perfumes of Arabia will not sweeten this little hand. . . . There's knocking at the gate. What's done cannot be undone." Carpenter in his " Mental Physiology " cites the case of a congenital idiot who at the age of 2 years lost her mother. When dying, at the age of 30, she arose in bed and exclaimed, " O my mother, how beautiful you look! " and fell back dead. It would be difficult to convince those who, by reason of accident or approximate drowning, have experienced a veritable judgment day due to hypermnesia, that we ever forget. As already seen, we recall in dreams many experiences which seem to be lost, while dreams may even add new knowledge. In dreams Mr. Hanna first gave evidence that he retained a knowledge of his past life. The writer had a dream in which a new homiletic fact was presented, clothed in new and appropriate language. Maury relates two cases in point which are cited by Huber: (1) A man lived during the first year of his life in a small town in the southern part of France, where his father had built a bridge. After he had become a man, during a dream, he was placed back as a child in the old French town and met a man

who said, "I am the keeper of the bridge," and who told him the chief facts about the construction of the bridge, which were subsequently found to be true. "Certainly," he says, "my dream informed me of what I did not know." (2) He had not seen Mount Brison for twenty-five years. In a dream he met a man from this place whose features were strange, but who represented himself as a friend of his father and who had known him in childhood. This subsequently proved to be true. Mathematicians while asleep have solved problems and worked out long associated trains of thought. It is this abiding character of memory that constitutes the indispensable factor in personality. It cannot be remarked by too many writers that without memory personality cannot exist. Memory has been defined, though for the moment I cannot state by whom, as that faculty which never loses anything and which registers everything. There is probably not a fact of value which we may learn, whether it be a fact in science or language, an anecdote, or a recipe, but will some day come back to enrich the life, or indeed has already enriched it and become part of the soul's permanent possession.

The second thesis about forgetting is that we are ever forgetting. Perhaps no one has lived who could say that he has never forgotten. The ability to recall everything has been ascribed to a few. Some instances were given in Chapter I of men who were said to have had unerring

memories. The Scaligers, father and son, are classical cases. Cicero said of Julius Cæsar, "He only forgets injuries." To Byron and Macaulay the tribute earned by Lucullus might be given, "Habuit divinam quandam memoriam rerum, verborum majorem." Henry Clay and James G. Blaine had remarkable memories for names and faces; yet Macaulay makes errors from trusting to his wonderful memory, which might have been avoided by a more copious use of notes, and the same statement applies to Niebuhr. The memory of Blaine and Clay for people might not have been developed had it not aided them in public life. U. S. Grant had a tenacious memory along certain utilitarian lines. The great memories were probably not equally tenacious for all subjects, and undoubtedly much that was at their command was not so definitely recalled as what was best known. This tendency, which I believe characterizes all mental life, is illustrated by men of ability whose memory is particularly weak in some direction. An ambassador forgot his name when calling at the Russian Court, to which he had been accredited. Lord Dudley invited Sydney Smith to dine with himself. "Come and dine with me," said Dudley to the great wit, "and I will surely have Sydney Smith present." The poet Whittier[18] is said to have applauded

[18] Cuthbert Hadden in the *Eclectic Magazine*, 123.

certain of his own verses, having forgotten that he had written them.

In the replies to my questionaire edited in the next chapter is the following incident. A professional man came from his study and asked his wife for his pen. She replied, "I have not had it." "Well, then, the children have. I told you that they must be kept out of the study." She replied, "If you will take the pen out of your mouth you will talk more plainly." The fact is, many are absent-minded to some things, which means being present-minded to others. There is in persons of every age a foreshortening of memory which may be emphasized somewhat in the case of old people. Mr. Ruskin in his later years thought that even the English weather had degenerated from what it was in his earlier years.[19]

"In the jolly winter
Of the long ago
It was not so cold as now—
Oh, no! no!
Then, as I remember,
Snowballs to eat
Were as good as apples now,
And every bit as sweet!"

JAMES WHITCOMB RILEY: *Old Man's Nursery Rhyme.*

We regularly refer all of our perceptions of distance to common standards. The memories of these perceptions, therefore, will not be accurate, but, like the perceptions from which they

[19] *Spectator*, lvii., 1038.

arose, will be foreshortened. Distance recalled after reading two minutes is found to be shorter than the same distance as perceived, and the perceived distance is shorter still than the same objectively measured.[20] Furthermore, it is absolutely necessary for our mental life that images become obscured and that we do not take enough notice of ordinary experiences to recall them readily. As Ribot said, "Forgetting becomes a condition of remembering." The overconscientious person who is afraid that he has forgotten some trifling detail of duty, the minds which cannot select important presentations but place mental accent upon all alike, make the witnesses who must give every petty detail or omit the material evidence. Such minds need only be alluded to as a warning. We become efficient in proportion as we forget. Thus the question is raised whether a good memory and a good understanding go together. That a mind which retains unimportant relations and mere trifles cannot be an acute intellect is easily seen. Yet this is only half of the truth. The other half is that great attainments are accompanied often by great penetration of intellect. Many of our intellectual giants have been endowed with remarkable memories. It may be nearer the truth to state that retention furnishes the material upon

[20] See "Notes on Mental Standards of Length" in the *American Journal of Psychology*, January, 1899.

which the reproductive and cognitive powers work. If there be no memory, there can be no intellect. If there be a great memory, and if what is remembered do not lie in the intellectual life as so much unused lumber, if it be worked over and utilized, forming a basis for suggestions and inferences, then the greater the memory the richer the intellect. But that there is a gradual dimming and fading of our mental images cannot be denied; nor need it be, for forgetting is one source of mental growth. The various stages of forgetting were well designated by Stiedenroth, who long ago wrote: "Forgetting admits of several degrees or stages. The first is a momentary displacement of an object apprehended which is yet certain to spring back as soon as the object displacing it is withdrawn. The second is a comparative withdrawal of the attention, as when we divert our mind from a painful sensation, or, as we say, forget it in labour or play. The third is when an object will not present itself spontaneously, but we must bethink ourselves in order to recover it. The fourth is when we bethink ourselves in vain. The fifth is when it has vanished for so long a time that we question whether by any effort we can bring it back. The sixth, when we conclude that it is absolutely certain that we shall never recall it again." [21]

[21] Cited by Porter.

We find, then, a current of memories, shifting, restless, forever changing, yet never lost. Events may come and events may go, but their traces last with life. Man might be defined almost as a being who is ever remembering and ever forgetting.

"It is mere memoriter," says the teacher, "mere memorizing." Yet memory of some kind is the basis of personal existence here, and, so far as we may judge, the only possible basis of individual immortality. The ancient Greeks did right in making Memory the mother of the Muses.

CHAPTER VI

INDIVIDUAL MEMORIES

Oft in the stilly night,
Ere slumber's chain has bound me,
Fond Memory brings the light
Of other days around me:
The smiles, the tears
Of boyhood's years,
The words of love then spoken;
The eyes that shone,
Now dimmed and gone,
The cheerful hearts now broken!
Thus, in the stilly night,
Ere slumber's chain has bound me,
Sad Memory brings the light
Of other days around me.

THOMAS MOORE.

IN this chapter we will consider the memory as it is really found to exist in a sufficiently large number of persons to constitute a general type. The results are here given of a study of the memories of normal people from nine months to ninety years of age.

At the outset a real difficulty is met which is well illustrated in the following extract from

[1] This chapter is a reprint from the *American Journal of Psychology*, January, 1899.

"Recollections of Childhood," by Sonya Kovalévski. She writes: "When I begin to sort out and classify my earliest recollections, the same thing always happens with me; these recollections disperse before me. At times it seems to me that I have found the first definite impression which has left a distinct trace in my memory; but as soon as I concentrate my thought on it for a while other impressions of a still more remote period begin to peep forth and acquire form. And the difficulty of it is that I cannot myself in the least determine which of these impressions I really remember; that is to say, I cannot decide which of them I really lived through and which of them I only heard about later on,—in my childhood—and imagine that I recall, when, in reality, I only remember the accounts of them. Worse still, I can never succeed in evoking a single one of these original recollections in all its purity; I involuntarily add to it something foreign during the very process of recalling it." She then describes a scene in childhood, and adds: "As I reflect upon the matter now, I think I must have been two or three years old, and that the scene took place in Moscow, where I was born." After the first memory she recalls "a series of detached but tolerably clear pictures," as of "picking up pebbles," and "my sister's doll which I threw out of the carriage window."

So many people have had the experience de-

scribed by this " marvel of mental development " that the question may fairly be asked, can most people ascertain their earliest memories with sufficient accuracy and certainty to render them trustworthy data for scientific results? In order to test whether the difficulty would prove insuperable, prior to the publication of the syllabus one hundred persons were personally interviewed, most of whom were more than sixty-five years of age. The results of these interviews were such as to lead to the belief that after all deductions are made there is a large residuum which is reliable. Moreover, the very difficulty alluded to is explained, at least in part, by the hypothesis advanced later in this study. The questionnaire read as follows:

1. What is your earliest memory? However trivial or childish, your earliest experience is wanted. Be sure that it is a memory and that no one has told you.

In 1, 2, 3, give your age at the time, at least the probable age.

2. In like manner, give your second and third earliest memories.

3. What is your earliest recollection of your (*a*) father, (*b*) mother, (*c*) sister, (*d*) brother, (*e*) playmates; (*f*) of any injury from a fall or a blow?

4. Of what four consecutive years have you the best recollection?

5. Of what four consecutive years after the first four have you the poorest memory?

6. Can you state examples of false memories experienced—e.g., have you recalled as real what you had merely dreamed, heard, or read? Give, if possible, a case of trans-

posed memory in which what happened earlier was recalled later, and what happened later was recalled earlier.

7. What book read before you were nine years of age do you recall best?

8. Do you recall pleasant or unpleasant experiences better?

9. What studies have best developed your memory?

10. Give a condensed account of any case of loss of memory caused by a blow on the head, a fall, or by disease.

11. Describe fully any aids to memory which you have found useful. How do you fix in mind and recall (*a*) figures, dates, dimensions; (*b*) forms of faces, microscopic structures, leaves, crystals, patterns, figures on the wall, carpet, or dress, phrases in music, and the cut of dresses? (*c*) How do you fix and recall passages of prose and poetry, declamations, and recitations? Why and how do you memorize fine passages? In learning foreign languages, describe devices for fixing new forms and phrases. Describe your system of keeping appointments. What memorandum do you keep, what book is used, and how do you make entries? As a student, how full notes do you take in the class-room? How would you teach a boy to remember things on time? Do you store up facts and dates, with no definite idea of how you will use them?

12. State cases in which the memory is so good or bad, that it weakens the other powers of the mind.

13. Describe cases of exceptional forgetfulness in old and young, stating whether it was due to distraction, abstraction, loss of mental power, or heredity.

As a rule, does defect in memory in children appear in the field of things done, known, or felt?

14. As you advance in years do you find the interval between the power to determine whether you have had an experience and the ability to define, locate, and name the experience wider or narrower? How is this in the kindergarten, high school, college, middle life, and old age?

The tabulation required almost incessant labour for five months. The results were first tabulated[2] in reference to topics and the age of the person reporting. A second tabulation was made in which the memories (which could be readily studied from the first tabulation) were arranged under a large number of headings (over sixty), these headings being drawn from the papers themselves. Such topics were used as novel occurrences, repeated or protracted occurrences, gustatory memories, auditory memories, memories of father, mother, brothers, sisters, more distant relatives, other persons, deaths and funerals, sickness and accidents to self, sickness and accidents to others, memories of time, number, etc. Under novel occurrences or single impressions were included such memories as seeing the ocean for the first time, drowning a cat, pet bird died, etc. By protracted or repeated experiences were included such memories as bringing water for mother in a little pail, the dress a person wore, etc.

To this topical syllabus 1658 replies were received in time for tabulation. Of this number 1372 were from white people; 605 males and 767 females. 182 were from negroes; 94 males and 88 females. 104 returns were furnished by Indians; 64 males and 40 females. The Indians

[2] I am indebted to my wife for the painstaking tabulations.

represented 25 different tribes. The tabulations were made according to age in periods as follows: I, ages 1–4; II, ages 5–9; III, ages 10–11; IV, ages 12–13; V, ages 14–15; VI, ages 16–17; VII, ages 18–19; VIII, ages 20–29; IX, 30–39, etc. The last decade was practically 80–89, although a few males and one female 90 years of age sent returns which were tabulated separately. The purpose in tabulating two-year periods from 10–20 was to note the changes in memory, if any occurred, during this period of growth. The returns furnished many memories besides the first three. While the whole number of early memories did not differ essentially in character from the first three, the former furnish broader data for safe conclusions.

The youngest child whose memory was obtained was eleven months of age. She had apparently two definite memories. These experiences may not enter into the list of permanent memories. Yet a few adults state that they remember experiences as early as one year of age,[3] and no definite limit can be set for the age of the earliest memories. The earliest memories of children under five years of age show the following range, the first number mentioned in each group of two representing males, and the second number females:

[3] This accords with the researches of V. and C. Henri. See *Popular Science Monthly* for May, 1898.

Novel occurrences or single impressions: fifteen, thirty-one; Protracted or repeated occurrences: sixteen, nine; Visual memories: twelve, sixteen; Auditory: four, two; Emotional: one, one; Gustatory: —, three; Motor: eight, nine; Tactile: one, two; Father: two, three; Mother: five, one; Grandparents: one, —; Brothers and sisters: two, one; Playmates: four, one; Other persons: three, two; Temperature: one, —; Topographical: seven, two; Logical: six, —; Clothing: five, one; School: —, two; Home: —, one; Visitors: —, two; Visiting: —, one; Running away: —, one; Corporal punishment: —, one; Dolls: one, nine; Sickness and accidents to self: five, three; Sickness and accidents to others: one, —; Deaths and funerals: one, —; Domestic fowls and animals: two, three; Fright: one, one; Colours: three, five; Playthings: four, four; Gifts: two, seven; Christmas: one, six; Playing: one, two; Activity of others: one, three; Attendant circumstances: one, —; Intellectual: one, —; Physical pain: one, —; Number: —, one; Trees: —, two; Mechanical: one, —; Teasing others: one, —; Time: one, —; Where slept: one, —.

It will be seen that the males have the greatest number of memories for protracted or repeated occurrences, for people, and clothing. They excel also in topographical and logical memories. The females have the better memories for novel occurrences and single impressions, for

Christmas, gifts, and, as would be expected, for dolls.

In the 5–9 period the males again excel in the memory for protracted and repeated occurrences, the females for novel ocurrences or single impressions. The motor memories here have a marked increase in the case of the females, and a slight increase for the males. The memory for all persons shows a noticeable increase with the females. For the males the personal memory improves for near relatives only. In the case of each there is a better memory for the activity of others.

In the next period—ages 10 and 11—motor memories decrease for the females and increase for the males. Memories of near relatives increase in the case of both, while memories for other persons decrease. Memories of sickness and accidents to self and of playing are emphasized.

In the 12–13 period the percentage of memories for novel occurrences decreases in the case of the females, while those for protracted experiences increase. Both males and females show a decrease in memories for near relatives, and an increase in those for playmates and other persons. Sickness and accidents to self are remembered less by males and better by females than in the preceding period. Memory for the activity of others increases in the case of the males and decreases in the case of the females.

In the period which includes those fourteen and fifteen years of age it is worthy of note that the motor memories nearly culminate for the males, but decrease in the case of the females. These memories seem to harmonize with the psychical and physical life of the period. Mischievousness and destructiveness are well remembered. The males have a decrease in the proportion of memories of novel occurrences, and an increase in those for repeated occurrences. The reverse is true in the case of females. The males show a marked decrease in memories for relatives and playmates and an increase in those for other persons. Topographical memories increase in the case of each, as do visual and auditory memories.

In the period 16–17 the relations are again reversed so far as novel occurrences and protracted experiences are concerned, the females showing an increase in memories for the latter and a decrease for the former. In the case of the males the opposite is true, and the percentages become essentially the same as in the period 12–13. The females show a slight increase in memory for all near relatives and playmates, and a greater increase in memory for other persons. The males show an increase in memories for playmates and relatives, and a decrease in memories for other persons. The females have a marked increase in the memory for fears, the males for the activity of others.

In the period 18–19 there is an increase in the visual memories for each sex, and the auditory memory of the females improves. The memory for the activity of others shows an increase in the case of each, and it is strongly emphasized for the males. The females excel in the proportion of memories for protracted or repeated occurrences, and the males in that for novel occurrences and single impressions.

The returns give evidence that the period of adolescence is one of great psychical awakening. A wide range of memories is found at this time. From the fourteenth year with girls and the fifteenth with boys the auditory memories are strongly developed. At the dawn of adolescence the motor memory of boys nearly culminates, and they have fewer memories of sickness and accidents to self. During this time the memory of other persons and the activity of others is emphasized in case of both boys and girls. In general at this period the special sensory memories are numerous, and it is the golden age for motor memories. Now, too, the memories of high ideals, self-sacrifice, and self-forgetfulness are cherished. Wider interests than self and immediate friends become the objects of reflection and recollection.

The decade 20–29 is perhaps to most people as important a decade as any. At this period there is a marked change in the memory content. For the second time the proportion of memories for

novel occurrences and for protracted or repeated experiences is nearly the same in the case of males and females. The males show a noticeable increase, and the females a marked decrease in visual memories. The same is true of the auditory memories. The memory for grandparents nearly culminates in the case of the females, and increases in the case of the males. The females show an increase in logical memories and a more decided increase in topographical memories than do the males. Memories of sickness and accidents to self decrease with the males and increase with the females, while in the case of both there is relative decline in the memories of sickness and accidents to others.

In the decade 30–39 memories involving reflection and thought seemingly ripen. The logical, intellectual, topographical, and visual memories for the males culminate here; also those for time, number, colours, and father. The visual and auditory memories of the females culminate, while the intellectual, logical, and topographical nearly reach the zenith. Memories for joy, quarrels, pride, jealousy, Christmas, physical pain, and weariness disappear. The predominant memories are of a thoughtful cast. This is a conservative period, as no new memories are introduced.

In the decade 40–49 memories for persons tend to fall away. One is almost surprised to find the motor memories of the females ascend and

reach their maximum. Their tactile memories also advance and culminate in the next period.

In the decade 50–59 the motor memories of the males culminate and again appear strong from 80 to 89. We have seen that they nearly reach their maximum at 14, and in all subsequent periods they are well represented. According to Ribot the motor elements are primary in all emotions, and they seem to be among the most abiding of memories. The memory of the males for physical pain and weariness culminates from 60 to 69; that of both males and females for school culminates from 70 to 79; and that of the males for wearing dresses from 80 to 90. The boy's first trousers are remembered best in the first and last periods of his life. In the last decade the chief classifications are still represented, but it is noticeable that the auditory and tactile memories entirely disappear in this period. Memories are no longer found for grandparents, sickness and accidents to self, gifts, and Christmas. On the other hand, visual memories and those for near relatives are well represented.

As already stated in the replies to the questions calling for the first three memories, a much larger number than three was frequently given. Moreover, other questions called for earliest memories of relatives, playmates, etc., so that a much larger number of memories was obtained than the first three of each individual. White persons reported, as the second tabulation shows, 6222

memories, 78 per cent. of which were novel occurrences or single impressions and 22 per cent. protracted or repeated experiences. The males had $76^{2}/_{3}$ per cent. memories for novel occurrences and $23^{1}/_{3}$ per cent. for repeated impressions. With them the memory for novel occurrences culminates in period VII, ages 18 and 19, when they constitute $83^{3}/_{5}$ per cent. of all memories. With females the memory for novel occurrences culminates in period III, ages 10 and 11, when they constitute 89 per cent. of all memories. They drop to $58^{3}/_{5}$ per cent. with the males during the two periods 70–79 and 80–89, but rise at 90 to $84^{3}/_{5}$ per cent. With the females they also drop to $58^{7}/_{10}$ per cent. in the period 80–89.

The memories of repeated occurrences in the case of the males culminate in the first period (ages 1–4), when they constitute $51^{3}/_{5}$ per cent. of the memories. They become $35^{3}/_{5}$ per cent. in period X, ages 40–49. With the females they are $22^{1}/_{2}$ per cent. in the first period, ages 1–4, and do not form a greater proportion except during three periods: VII, ages 18 and 19, when they are $27^{3}/_{5}$ per cent., XI, ages 50–59, and XIV, ages 80–90, when they become $31^{9}/_{10}$ and $41^{3}/_{10}$ per cent., respectively, of the whole.

The fact that different memories culminate at different periods may be significant. In not a few instances they seem to bear a relation to the whole mental life of the period. In order to

determine this relation more definitely we shall now consider the periods when the memories more frequently found become a chief factor and reach their highest percentage. The visual memories are $27^1/_3$ per cent. of the whole for the males and 31 per cent. for the females. In the case of each they are a large factor in the first period, 1–4, when the child is exploring the world. With both males and females they culminate in the fourth decade, 30–39. In this period observation is ripest. In the case of the males the percentage is low in the eighth and ninth decades, 70–89, and improves in the tenth, as if second sight were obtained. The auditory memories become accentuated with the males in period VI, years 16 and 17, and culminate in years 20–29. With the females they become emphasized in period V, years 14 and 15, and culminate in years 30–39. The periods of culmination are epochs when the auditory sense is much used as a rule. Men and women are busy, "hear what is going on," and do not spend much time in reading. It is worthy of note that in the period 80–89 for females and the 90 period for males, an age when the hearing is poor, there are no auditory memories. The motor memories come in great profusion at 14 and 15 for the males; at this period the motor memory is intensely motor, of a break-bone and accident nature. On the other hand, with the females at this period there is an actual falling off of 4 per cent. in motor memories. The motor

memories, however, in case of the males, culminate in years 50–59 by a margin of $3^1/_2$ per cent. over the 14 and 15 period, and with the females reach their maximum at 40–49. This may not be explained easily, but it is a period of life when activities have fallen away little, if any, and achievement and the results of activity are the objects of reflection.

The memories of brothers, sisters, and playmates culminate in the seventh period for females, and in the eighth for males, and then steadily diminish until second childhood begins. The memory of females for the mother exceeds that of the males by $4^1/_4$ per cent., while males have a better memory for the father than females. The memories of the males for their grandparents reach the highest points at (*a*) 5–9, (*b*) 30–39, (*c*) 60–69; those of the females at (*a*) 5–9, (*b*) 20–29, and (*c*) 50–59, the years (*a*) when they have most to do with their grandparents in their own home, (*b*) when their children are small and their own parents first become grandparents, (*c*) when they become grandparents themselves. The natural interval of ten years between the ages of males and females in the last two cases may be noted. Memories for deaths and funerals are recalled by the females almost equally well in the years from 60 to 90, and are not strongly marked before this time. Those of the males culminate at 90, but are very marked from 70 to 79. Is it not true that the memories of

any period are in harmony with the general psychical life of that period, and do they not to a certain extent partake of its qualities? These facts suggest that what is remembered does not primarily constitute definite memories, but a memory complex. From this complex, at subsequent periods of life, those parts are selected out and made distinct which are *en rapport* with what may be termed the memory tone of the period; e.g., if the period be one in which the auditory sense is much used, or be one of great logical activity, auditory or logical memories will be prominent. This hypothesis explains the cases of individuals in whom certain types of memory are pronounced. It also explains those cases in which persons assert that they cannot single out early memories. "It is all one mass," they say. Such minds are little given to reflection upon the distant past. They have not tried to separate the single elements of the complex. When they consent to reflect for a time, they are usually able to differentiate single elements and to arrange them in serial order. Yet what these elements are will differ with the age of the individual or with his memory tone. The memories for sickness and accidents to self culminate for the females in years 12 and 13, and for the males in years 14 and 15. Sickness and accidents of others are best recalled by the females in years 14 and 15; by the males in period 12 to 13. Females have the better memory for sickness

and accidents to others. Males have the better memory for sickness and accidents to self. The activities of others are best recalled by both males and females in the closing periods of their lives.

In the general average for the whole life it is interesting to note that the females have a slightly higher percentage of visual, auditory, gustatory, and tactile memories than the males. The gustatory memory is $3^{7}/_{10}$ per cent. for the females, and culminates in the first period, while among the males it is $2^{3}/_{4}$ per cent., and culminates in period 5–9. Memories for odours are very few, being $^{1}/_{4}$ of 1 per cent. for the males and $^{1}/_{13}$ of 1 per cent. for the females. The males have 2 per cent. more logical memories. The females have from $2\,^{1}/_{2}$ to 4 per cent. better memory for mother, playmates, and other persons. They have $7^{1}/_{2}$ per cent. better recollection of brothers and sisters, and 7 per cent. less of topographical memories, than the males. Motor memories, father, grandparents, gifts, playthings, and fears, are about equally recalled by each, but the females have double the memories for playing. The female memory for dolls is $3^{2}/_{3}$ per cent., and culminates in the first period, years 1–4, when it is $22^{1}/_{2}$ per cent. of all memories. The male memory for clothing is 6 per cent., the female $7^{1}/_{5}$ per cent. The males have 7 per cent. of school memories, the females $5^{1}/_{2}$ per cent. The memories of the males for home are $1^{1}/_{2}$ per

cent., of the females $^{9}/_{10}$ of 1 per cent. The males have nearly 8 per cent. of memories for domestic animals and fowls, which culminate in period 40–49; the females have only $2^{1}/_{4}$ per cent. of such memories, which culminate in period 50–59. Time has $2^{8}/_{10}$ of memories with each. Number memories are $1^{1}/_{4}$ per cent. for the males and a little less than one per cent. for the females. Memories of colours are $4^{1}/_{4}$ per cent. for the females, $3^{1}/_{3}$ per cent. for the males. The males have $2^{2}/_{5}$ per cent. of memories of deaths and funerals; the females $1^{1}/_{2}$ per cent. Memories of trees are $1^{1}/_{4}$ per cent. with the females and $^{4}/_{5}$ of 1 per cent. with the males. The following memories should also be mentioned: Picture taken; pride; visit to dentist; quarrels; storms; money; jealousy; shame; lie; selfishness; curiosity; birthdays; being lost; deceit; stealing; picnics; circus; parades and soldiers; praise; temperature; visiting ($4^{1}/_{4}$ per cent. for females, $2^{1}/_{4}$, males); visitors ($2^{1}/_{4}$ per cent. for females, $1^{1}/_{4}$, males); reproof, which is remembered one-third as well as corporal punishment; running away; mud pies; crying and grief; anger; attendant circumstances; fishing; swinging; hair; sliding; physical pain; fatigue; malice; losing things; being praised; enemy; birthday; laughed at; playing horse; imitation; where slept; destructiveness; being kissed; disobedience; church; wedding; surprise; jealousy; teasing; mischief; guilt; blood; charity; revenge; working; supernatural;

love; sorrow. The last eight memories are found for the first time at senescence.

The average age for the earliest three memories at different periods under the age of 25 is shown by the curves here given. The continuation of the same curves during the remaining periods is described. Fig. 28 represents the earliest three memories of the males, and Fig. 29 of the females. The heavy line represents the first memory, the broken line the second, and the dotted line the third memory. Distance to the right represents the age of the person reporting; distance upward indicates the age of the person at the time of the occurrence remembered. For the first memory during the entire period it is less than three years. The first rise in the curve is naturally marked because it begins low at the age of 1. It drops at $4\frac{1}{2}$ and 5 for the first two memories, which may be due to some acquired ability to reflect upon the past. Children under this age have not been given to reflection, and it is very difficult to get them to bring forth the memories which later years will prove that they already possess. There is a rise in all of the curves at adolescence which is emphatic in the case of four of them. This shows that from the age of 13 to 15, boys and girls do not recall so early memories as others do before and after this period. At this period the present is large and the future makes a strong appeal. While the storehouse of memory is very rich now, perhaps

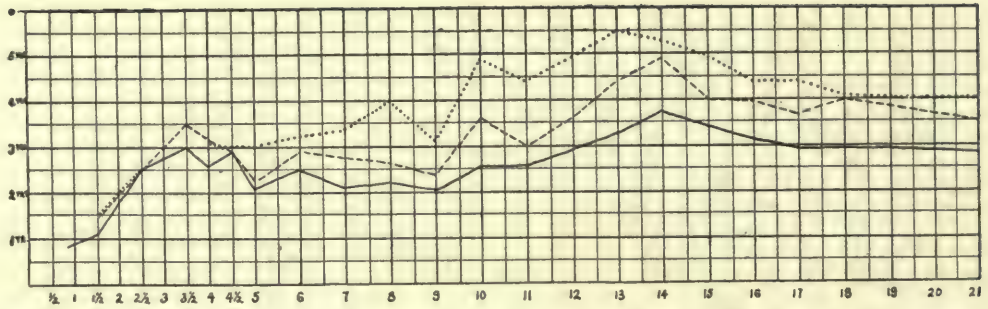

FIG. 28.—Curves representing the earliest three memories of white males.

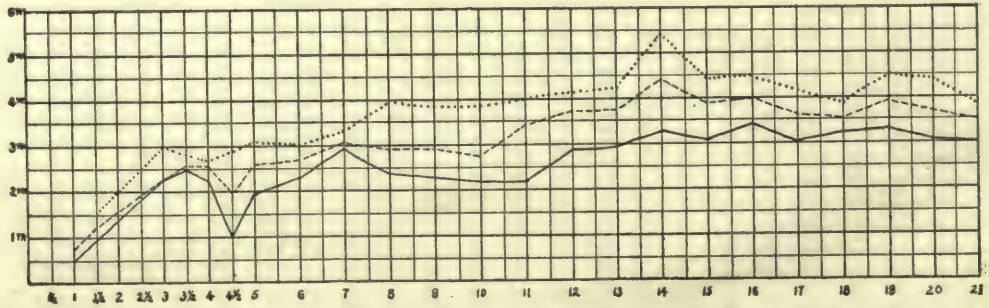

FIG. 29.—Curves representing the earliest three memories of white females.

the temperament or the psychical tone is wanting in accordance with which painstaking reflection calls forth the earliest experiences. At any rate the earliest memories of boys at the age of 14 average almost four years, and for the girls it is more than three. At 35 the curve for the males descends and approaches two years, which is the average age for the first memory of boys at 9 and 5 years of age. The curve for the earliest memory of the females descends slightly at 30 and 40, and then fluctuates, rising slightly at 80 to descend again. The curve for the males rises at 70, and descends gradually, later terminating in the height reached at 6, 10, and 11.

The curves for the second and third memories call for no discussion, as the representation is apparent. They show, however, a tendency to sympathize with the first. One fact seems clear from this study: There is not a progressive fading out of memories as life advances and declines. The range of subjects recalled may narrow a little toward the close, but if a corresponding amount of data could be gathered, even this might be doubtful. The garrulous mode of talking prevalent among old people seems to be due to complete associations in which few petty details are omitted. Moreover, the memory of the aged goes back practically as far as does that of young people, and is as clear and vivid. On the farm at my early home is a trout-stream whose waters are clear and cold. In childhood I saw the tree-

tops and mosses mirrored in the clear waters. The stream has narrowed down a little owing to the cutting away of the forest. The branches now reflected there have changed somewhat, not by time, but by elements at work in time. If in old age I see them, the branches may be the same, but changed a little more. Such is the memory stream, narrowed a little it may be, in the passing years, but the waters, flowing as clear as ever from the same springs, mirror the old experiences.

Comparing the Indian males with the white males of the same period, the Indians show a higher percentage of memories for hearing, taste, mother, and playmates, crying and grief, corporal punishment, trees, quarrels, and almost double for domestic fowls and animals. They have a higher percentage of tactile memories, and a smaller per cent. for dress and persons not relatives. The following memories are wholly or chiefly Indian: Fishing, snakes, squirrels, negroes, hunting (bow and arrows), lakes and streams, and tobacco.

Comparing Indian females with white females of the same age, the Indians have a larger percentage of auditory, gustatory, and motor memories, also for father, mother, playmates, fear, and dolls; much greater for crying and grief, and double the percentage for domestic fowls and animals. They have a smaller percentage of memories for persons not related, dresses and

other clothing, fewer topographical and logical memories, and less for sickness and accident to self and others, and for the activity of others. The following memories belong wholly or chiefly to the Indians: Lakes, rivers, wolves, coons, owls, fishing, skating, and negroes.

The Indians who sent returns represent 25 different tribes, and may be considered fairly representative. Some of the tribes are in a low state of civilization, but many came from families of wealth and culture. Many of these memories may be termed crystallized racial experiences, and the question arises whether the memory tone is not modified by atavistic tendencies. As will be seen later, their memories for pleasant and unpleasant occurrences savour of racial experiences. The curves for the first three memories of both males and females average higher than those of the whites. That for the earliest memory of the males fluctuates between 3 and 4 until the age of 21 is reached. At this point it drops below 3, rises from 21 to 22, drops again, and with the curve for the second memory reaches its lowest point at 26. The third memory for this period is high, and in one instance reaches the age of 9. The curve for the earliest memory of the females reaches its lowest point by a rapid descent at 25. The second and third memories of both males and females average 4 and 5, respectively.

The curves for the age of the negroes at the

time of the first three memories show a higher average than those for the whites. The earliest memory of the males is usually found between 3 and 4. The curve representing it is lower than 3 at the ages of 14 and 15; it also descends to 3 at the ages of 23, 24, and 27. It is high from 16 to 18, and culminates at 22. The second earliest memory ranges from 4 to 6, but at the age of 14

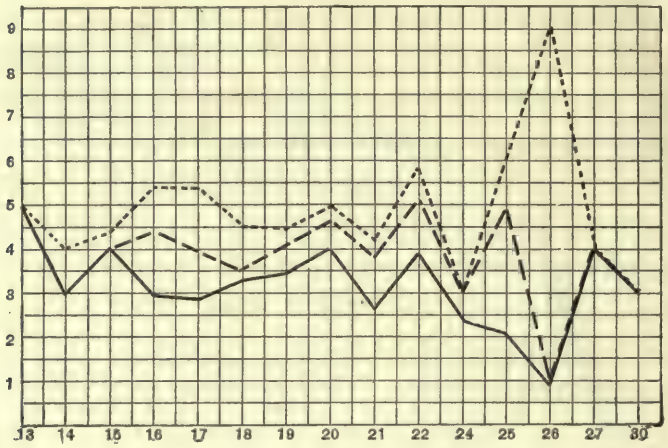

FIG. 30.—Curves representing the first three memories of Indian males.

drops below 4. The curve for the third earliest memory fluctuates from $4\frac{1}{2}$ to 9. The curve representing the earliest memory of the negro females descends to 2 at the age of 25, and at this period the second earliest memory descends to 3. The curve for the first is higher at the age of 26, when it is 4+. The curve for the third memory is noticeably high during the period from 14 to

16. The first and second are high from 15 to 17. The curve for the third memory is high again from 19 to 25, when it descends. The curve for the second memory, like that for the first, falls at 22, and both reach a very low point at 25.

The negroes do not seem to differentiate the memories from the memory complex until late in life. This may be due to the poverty of the mental experience in early life. The memory tone is monotonous. Further evidence of this is a strong tendency to remember by comparison. Such an event occurred in "Garfield's or in Harrison's administration," or "after I went to school." But the best educated negroes, as would be expected, have sharply defined and well differentiated early experiences. Their memories, too, have less of the grotesque character. The story of hardships, wrong, and suffering is deeply imprinted on many memories.

It was to be expected that the negro females would place emphasis upon dress. The racial experience also crops out. One could hardly find an Indian or white child afraid of a candy sheep's head because the teeth showed, but this was the earliest memory of a negress.

The replies to questions 4 and 5 were tabulated together with replies to questions asked persons past fifty years of age regarding the decades best and poorest remembered. The years best remembered by males of all ages are the 16th and 17th, which are recalled equally well. The 15th

year comes next, followed by the 19th and 14th in the order given. The poorest remembered year is the 8th, and the second poorest the 7th. From 46 to 50 there comes a tendency to remember the last four years or the last decade most poorly, and the red lines, representing the best remembered years, and the black lines, representing the poorest remembered years, mingle together. After this period, as a rule, the last four years, or the last decade, is least remembered. There are notable exceptions, however. A few represent the whole life after the first four years, as best recalled, and know no poorest memory. The statement is made by persons past 80 that they still recall well passing events in which they become interested, and to which they give attention. Middle-aged people frequently designate the years 20–25 or 25–30 as the best remembered, for the reason that important changes were then occurring.

The poorest remembered year for the females also is the 8th, and the next poorest recalled is the 7th. Their best remembered year is the 15th. At the age of 50 the lines representing the best and poorest recalled years mingle freely, and after this the tendency is to recall the last four years or the last decade with the greatest difficulty. Here, too, are notable exceptions. It is worthy of note that the years poorest recalled by all persons are the 8th and 7th, respectively. For all persons the years best recalled are those charac-

terized by the great psychical and mental awakenings of adolescent life. It is true that after 50, proper names, at least, are not so well recalled. An explanation given by the returns is that middle-aged people have many more acquaintances and fewer intimate friends. The early memories abate little to the last. At every period attention and interest are the handmaids of memory.

The sixth question called for false memories. The returns fully justify the discussion in a previous chapter as to the influence of dreams. There are inverted memories, and defective localization in the past is fairly common. The period 16–19 is that in which false memories are most common. The experience at this age is fairly common to both sexes, but the males are able to give fewer definite examples. Yet, while false memories are more common at this period, no time of life seems free from them.

Y. F., f., age 16. Read of robbery in paper, and told it as seen.

A. N., f., age 16. Told playmate a dream, and was punished for lying.

A. B., f., age 17. Four years ago I dreamed a person was dead, and supposed it was true until I met her a year ago.

M. C., f., age 17. Dreamed of a fire, and the next day asked if a friend went to it.

L. C., f., age 17. Dreamed that the price of potatoes had gone up, that mother had told me so. Found out my mistake at the dinner-table.

F. C., f., age 17. Dreamed mother had bought me a new dress. Looked for it all over the house.

M. D., f., age 19. Told teacher of a visit to Washington. Had never been there.

H. D., f., age 17. Dreamed uncle had come to visit us. Next morning asked mamma if uncle had come down to breakfast yet.

T., f., age 9. Mistook event near close of voyage home from Scotland to have been on the outward voyage.

M., f., age 17. Visited a friend five summers ago. The friend visited her seven summers ago. M. states that she made the first visit, and no amount of explanations and dates changes her mind.

T., m., age 19. Member of foot-ball team, in writing from memory a report of the games in which he played, often related events as occurring at the beginning of the game which, as a matter of fact, occurred later. This was brought to his notice by men who stood on the side lines and kept running notes of the game.

F. W., m., age 26. College graduate. Thought aunt told me something coming home from a funeral 8 or 10 years ago. Recently learned that she and I returned from the funeral in different carriages, and that it was told me by another relative.

A. F., m., age 18. Often thought I was at a feast in the woods before I was born.

R. C., m., age 15. Have an impression of having done something ages before.

C. B., m., age 17. Dreamed there was a train of cars in the closet for me, but found none.

E. L., m., age 14½. Dreamed I had a bushel of pennies, but could not find them.

A. H., m., age 19. Dreamed of landscapes which I never saw. They seemed real.

Some of the dreams may remain permanently as real, but they are apt to be corrected by experience.

Question 7 called for the book read before the age of nine which is best recalled. Books which appeal strongly to the imagination constitute a large portion of those mentioned. The influence of rhyme also apparently aids the memory. The books most frequently mentioned, 180 in all, fall under the heading of light stories and nursery rhymes. While short children's stories are included, the "Mother Goose Melodies," "Jack and the Beanstalk," etc., make up a large part of this heading. The younger people, especially, recall the pictured story books which they have seen in rich profusion. Here might have been placed "Little Lord Fauntleroy," mentioned by 14, and "Babes in the Wood," by 3.

The second division comprises novels, which lead school books by the slight margin of 92 to 90. The list of novels might be largely increased, however, by books mentioned separately, and which were not included in the above estimate. Such are "Pilgrim's Progress," remembered by 20; "Black Beauty," by 17; "Uncle Tom's Cabin," 14; "Oliver Twist," 3; "Beautiful Joe," 1; "Tom Brown's School Days," 1; "Rip Van Winkle," 3.

Fairy tales by Grimm, Andersen, and others come next, 82, not including "Cinderella," 25; "Arabian Nights," 5; "Æsop's Fables," 2; "Blue Beard," 8.

Returning to novels, one separated from the general list is designated almost as many times as

are all other novels. It is "Robinson Crusoe," mentioned 71 times. "The Swiss Family Robinson" is mentioned 25 times, "Gulliver's Travels" twice. Of other books Bible stories are designated by 43, didactic works by 11, biography by 14, history by 13, natural history by 16. "Little Men," by Miss Alcott, is mentioned by 9, and "Little Women" by 16. A middle-aged man writes that he recalls "Little Men" better than any book he has ever read. Essays are mentioned by 3, Moody and Sankey Hymn Book by 1. "The Scrap Book" and "Brownies" have one vote each. "Peck's Bad Boy" is mentioned twice.

The pedagogical significance is unmistakable. What appeals to the child's imagination interests him, and as a result remains in memory. Historical and didactic novels are most potent of the permanent influences. Scott and Lord Lytton, not mentioned here, if read early will be remembered. The Bible stories are the portions of sacred Scripture best suited to the child. Biography is well remembered and most instructive. There could be no better reading to appeal to the permanent interest of the young than some of the best of Jowett's "Dialogues of Plato."

"The thought of our past lives in me doth breed perpetual benediction."

A large number of replies were received to the inquiry, "Do you remember pleasant or unpleas-

ant experiences better?" The replies are illustrated by the curves here given.

The figures at the bottom give the age of the persons interviewed; the height of the curves gives the relative number of replies; the heavy lines representing those who remember the pleasant better, the broken lines those who remember the unpleasant better, and the dotted

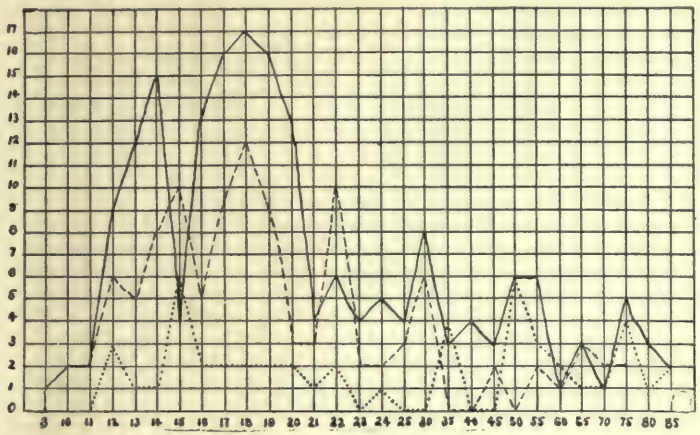

FIG. 31.—Curves representing the pleasant and unpleasant memories of white males.

lines the number who could make no choice. It is the relative rise of the curves representing the pleasant and unpleasant memories, and not the absolute rise of one at any point or points, that is significant.

As will be seen, the pleasant and unpleasant memories of the male whites rise and fall together until the age of 21. At 22, in the case of the males, the curve for unpleasant memories is

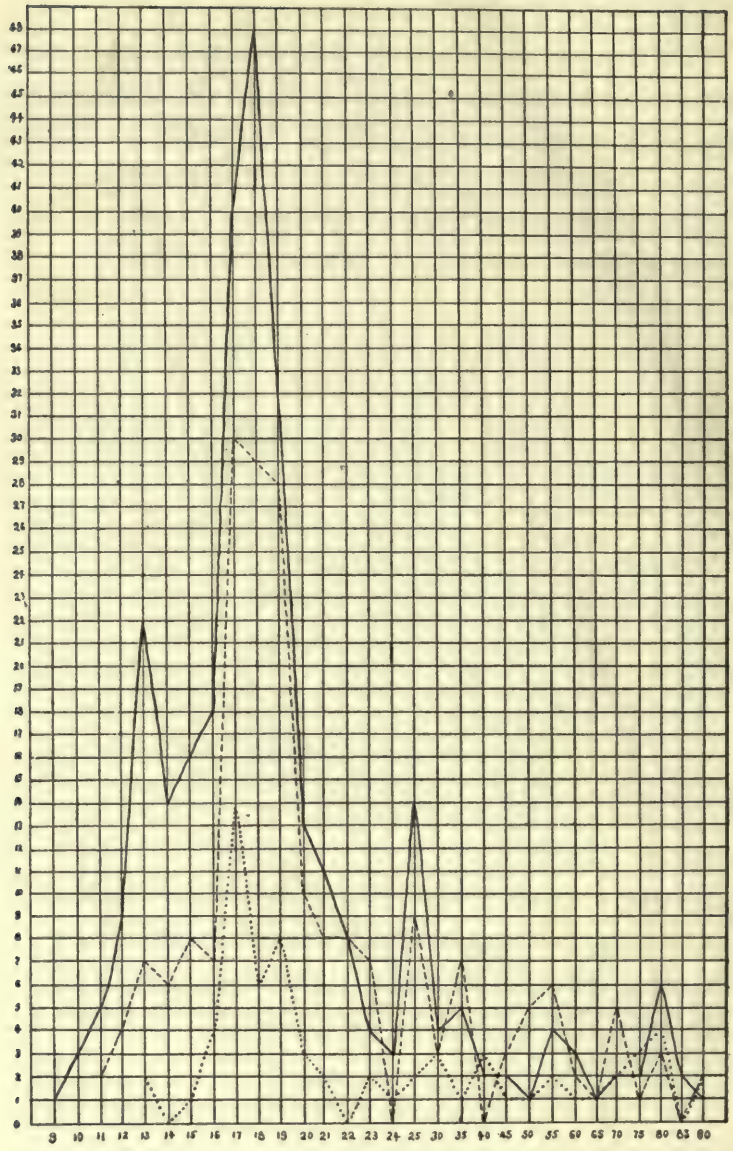

FIG. 32.—Curves representing the pleasant and unpleasant memories of white females.

the higher, after which the pleasant memories are in the ascendency. After the age of 30 unpleasant memories are little recalled by the males.

The unpleasant memories have a larger share in the woman's mental life than in that of the man.

The unpleasant memories play the important rôle in the case of the Indian and negro males. One can hardly fail to see in it a suggestion of persecution and slavery. The Indian females show a slight tendency toward remembering unpleasant experiences best, and share the sorrowful experiences of their brothers. On the other

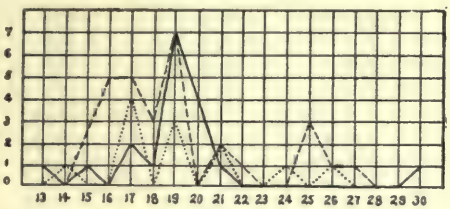

FIG. 33.—Curves representing the pleasant and unpleasant memories of Indian males.

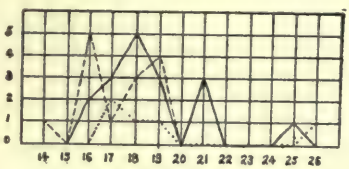

FIG. 34.—Curves representing the pleasant and unpleasant memories of Indian females.

hand, in the case of the negro females, unpleasant experiences play a very minor part indeed.

With them a dress of striking colour appears easily to efface grief.

For many years the warning against memoriter work has been so persistent that one almost feels like apologizing for asking the question—

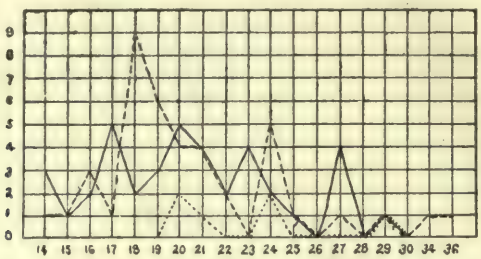

FIG. 35.—Curves representing the pleasant and unpleasant memories of negro males.

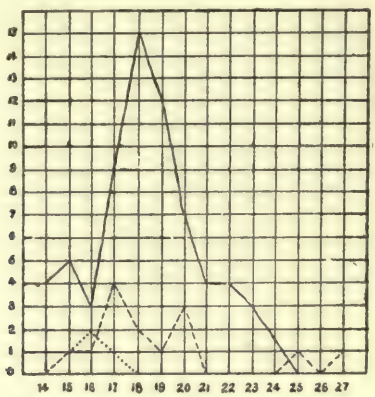

FIG. 36.—Curves representing the pleasant and unpleasant memories of negro females.

"What studies have best developed your memory?" The thesis that memory ought not to be trained has been supplemented by the other that it cannot be trained. These ideas have made for advancement. They have also wrought injury.

Have college students the ability to-day that they had fifteen years ago, to reproduce an author's thought and to think while upon their feet? The question in the topical syllabus called forth a great number of replies. Almost all of the studies in the curricula of high schools, normal schools, and colleges are mentioned. We must allow for the fact that studies most commonly pursued will be mentioned most frequently. History easily takes the precedence, being mentioned 229 times. Some specify learning the dates, but with the great majority the work of fixing the salient points at different epochs, and wide collateral reading, are believed to have aided the memory. It is but natural that a close ally, geography, should come next. It is mentioned 147 times. Arithmetic comes next, having 124 votes. Many specify the committing of the rules and tables. The tables for denominate numbers form an admirable memory drill. Geometry is mentioned 66 times, and algebra 27 times, while mathematics is mentioned 55 times. In certain schools where the mathematics are well taught they have a large percentage of votes. Latin is mentioned 67 times, some add "When taught in the old way." No other language is to be compared with the Latin in the number of its adherents, although Greek is mentioned 8 times (many more have studied Latin than Greek), French 7 times, German twice, and Language 19 times. If this be true of foreign languages, we are

not surprised to find that English literature has 74 votes, English grammar 47, poetry 45, general reading 36, recitations and declamations 30. Many state that their memory has been improved by memorizing gems of literature. Spelling is mentioned 27 times, science (general science) is mentioned; chemistry and physics are each named 5 times, physiology 14 times, botany twice, and zoölogy 3 times. Music is mentioned 8 times. Other studies named are moral philosophy 1, psychology 11, drawing 1, catechism 3, Bible verses 9, pedagogy 1, political economy and civil government 1 each. The Indians mention shorthand and phonography as helpful in training the memory. They also give other studies mentioned by the whites. The negroes, with two exceptions, refer to text-books and other books mentioned by the whites. It is probably true, as stated in another chapter, that nature assigns memory limits to each individual. There is as little doubt that within the limits assigned by nature the memory is susceptible to training, and is developed more by some studies than by others.

The request contained under heading 10 of the syllabus, " Give a condensed account of any case of loss of memory caused by a blow on the head, a fall, or by disease," elicited a number of suggestive replies. These results are not significant as compared with the carefully collated results in Chapter III. They show, however, that loss of

memory due to traumatism and disease are fairly common and carefully observed by the folk-consciousness. Instances given are as follows:

I. J., m. Head injured during foot-ball game. Could not remember signals.

Grandmother in usual health lost all memory for 1½ days.

M., f. Suffered nervous prostration, had to learn A B C's over. She afterward became a high-school teacher, but was forgetful.

E. G., f., age 19. Crossing the ocean at the age of 11 forgot all she had learned. It came back at the age of 13.

M., f., age 7½. Broke arm. Next day asked why it was tied up. Had forgotten the name of the pussy cat, etc.

B., age 8. Scarlet fever, forgot everything, and had to learn over.

A number of instances were given in which the secondary automatic movements of children were lost by disease.

E., m., age 2. After a fever he had to learn to walk over again.

Man fell. He did not know his own name for 2 years. After the death of his wife it all came back to him.

Man fairly educated, after typhoid fever had to learn to spell.

M. W. Fell down-stairs three years ago. Cannot remember names since, nor can he identify persons.

F. Can recall nothing which transpired before an illness at 6.

Child fell from barn. Forgot being on the barn.

Quinine affects the memory of one.

L. L., f., age 15. Crossed Pacific Ocean at 4, sick, forgot Chinese language. It came back upon return to China 2 years later.

That the memory is affected by the state of the physical health is a widespread popular belief due to experience. A " close, stuffy room," and " lack of mental power due to fatigue," are mentioned as prejudicial to a good memory.

E. M., f., age 18. Broke limb at 9, took chloroform. Memory for years 1-9 poorer since. She attributes it to the chloroform. Others believe that chloroform has affected their memory.

H. K., Indian, age 24. " I was playing football, and once while running with the ball I was tackled by an opponent, who threw me on the flat of my back, with his own weight on top of me, my head striking the ground at the same time or a little before my body did. I got up in a little while, said I was not hurt, for I felt no pain, so they began playing. They called the signals and I stood still. I could not place the meaning of the numbers. I did not even know my own number, so after the play was made I stepped to the other 'half-back' and asked him what my number was. Before the fall I knew the signals as well as any man on the team. Of course I had to retire from the field. I could not remember from one minute to the next. I knew what I was doing, and knew at the time that I could not remember a thing. There were three days that I could not remember anything. It just seemed that a door would shut on everything I did, and in less than a minute I would be doing the same thing over again."

A well-known pedagogical principle is that vivid impressions are easily recalled. With frequency, recency, and emotional congruity, vividness plays an important rôle in association. In order to test the abiding character of a vivid experience 179 middle-aged and aged people were

asked in personal interviews the following question: "Do you recall where you were when you heard that Lincoln was shot?" An affirmative answer required the exact location, an example of which is the following reply: "My father and I were on the road to A——, in the State of Maine, to purchase the 'fixings' needed for my graduation. When we were driving down a steep hill into the city we felt that something was wrong. Everybody looked so sad and there was such terrible excitement that my father stopped his horse, and, leaning from the carriage, called: 'What is it, my friends? What has happened?' 'Haven't you heard?' was the reply—'Lincoln has been assassinated.' The lines fell from my father's limp hands, and with tears streaming from his eyes he sat as one bereft of motion. We were far from home, and much must be done, so he rallied after a time, and we finished our work as well as our heavy hearts would allow."

Not all the replies were so vivid as this one, but only those were accounted as affirmative which contained facts as to time of day, exact location, and who told them.

J. P., age 76. I was standing by the stove getting dinner. My husband came in and told me.

M. B., age 79. I was setting out a rosebush by the door. My husband came in the yard and told me. It was about 11 o'clock A.M.

H. R., age 73. We were eating dinner. No one ate much after we heard of it.

J. T., age 73. I was fixing fence, can go within a rod of the place where I stood. Mr. W. came along and told me. It was 9 or 10 o'clock in the morning.

L. B., age 84. It was in the forenoon; we were at work on the road by K.'s mills. A man driving past told us.

Of the 179 persons interviewed, 127 replied in the affirmative, and were able to give full particulars; 52 replied in the negative. A few who gave a negative reply recalled where they were when they heard of Garfield's death. Inasmuch as 33 years have elapsed since Lincoln's death, the number who made an affirmative reply must be considered large, and bears testimony to the abiding character of vivid impressions.

Many helpful pedagogical suggestions were received from high-school, normal, and college students in reply to question 11. Figures are mentally represented as clearly as possible,—a "picture of them as they look printed or written." A child thought of the figures to be carried in division as "gone up in the attic." He would "call up attic to see if anything was there." One "locates them on a certain page of a book." Several "write them a few times." Three visualize in coloured terms. Female, age 19, recalls the letter A as black on a red background. Female, age 21: "Words seem coloured. My name is red, my sister's is yellow. I often remember by colour." Male, age 18: "I remember figures by colour." Association helps. A college student writes: "I

associate figures with what is familiar. If I hear that Mr. A. receives $5000 salary, I say to myself that is five times as much as my old schoolteacher got. After this the salary is easily recalled." Place localization, and association, are chiefly relied upon. Some have a kind of mnemonic system, and group or reverse the numbers. One associates the figure 8 with a doughnut. 3.1416, the ratio between the diameter and the circumference of a circle, is fixed by serial association, repeating the figures in order: 3.—1.4. 1.6. (3, one 4, one 6). The same aids are employed for dimensions. The most efficient mnemonic aid for dates is to associate them with important events, e.g., 1492, 1776, etc. Dates of minor importance are associated with these. Charts are recommended. Some make rhymes for dates, getting the idea, perhaps, from the way the presidents of the United States or the rulers of England are remembered. One sees figures in a winding row.

Faces are recalled by types. After fixing the type to which it belongs, the eyes, hair, nose, cheek-bones, complexion, and scars are noted. A college student writes: "I try to trace a resemblance between a strange face and one I know." A middle-aged woman takes careful notice of the hand. She has a poor memory for faces, but can often locate the person by the hand. A normal student writes the initial of the person or place on the left hand. After it has

been erased she still visualizes it there. One analyzes the features. "If any feature resembles a well-known face, it is easily recalled."

Microscopic structures and crystals are fixed by drawing them. Drawing is the chief aid. Here, too, clear visualization counts. "I see them floating before my eyes." Localization in place is a help.

Leaves are remembered by the form, colour, number of lobes, the veining, margins, and by comparing them with other leaves. Figures of wall-paper and carpets are associated with the room, the house, or are localized in time. Here forms are also fixed by drawing, "even by tracing them in the air." The colour, shape, and, above all, striking characteristics of figures are noticed.

Phrases in music are recalled by playing, or by attempting to play, or by humming the tune. College student, m., age 22: "I recall the time-intervals and note the first part of the theme; I recall the rest by association." Female, age 17, normal student: "I remember phrases in music by thinking if they are similar to phrases in any selections that I have heard." Constant repetition and association of the selection with the person who played or sang it are helps frequently used. "If I get one measure as tone,—be it first or last,—the rest comes without effort." Female, age 34, recalls sounds, not appearance, of notes. Her memory for

sounds was strengthened by taking music lessons. One recalls music by an imaginary curved line going up and down with the tone. One thinks of whole rests as heavier than half rests, and consequently falling below the line. One boy thinks of the notes as Chinese climbing a fence. With another it is secondary automatic,—"my fingers remember the music." The Indians find that sheer determination helps them to remember music, as other experiences.

The negro males gave,—by sound, visualizing, position of notes on the staff, some initial note is the key to the whole, music just comes up. Negro females remember (*a*) phrases in music by accent; (*b*) by sounds, time, and words; (*c*) where they saw them last; (*d*) by mental picture of the notes. The familiar mnemonic sentences are given for sharps, flats, and keys: "God deluged all earth by floods," "Foolish boys eat apple dumplings greedily," "Fred Coburn goes down after each boy."

It is worthy of note that some excellent musicians recall music better after an interval. They cannot immediately reproduce it if they have enjoyed it intensely. Sometimes an interval of a day or two is necessary in order to recall it well. It is quite possible that there is a modification of the basilar membrane which serves as a basis for subsequent recall. Furthermore, it is true that many people find that a time interval is necessary to recall well any experience.

E. C., f., age 17, recalls better now what happened in all school grades than when she was younger. Male, age 20: "I can define and locate my former experiences better now than I could a year or so after they happened." Female, age 19: "I can recall now things that happened 8 or 10 years ago, which I could not recall 4 years ago." Apart from a maturer mind, perspective seems to be necessary to many in order that they may have a good memory.

The cut of dresses is recalled by association with the person who wore the garment. New features are noted. The different parts, as neck, yoke, and skirt, are studied by one. Association with place and person is the chief aid.

Passages of prose and declamations are memorized by paying attention to the thought. After the thought is fixed it easily clothes itself in language. Not a few, however, memorize mechanically, attention being paid especially to the beginnings and endings of sentences. Repetition and reading aloud are frequently mentioned. Clear mental representation and a purely local memory are of service. Male, 17: "I usually memorize by imprinting the object and its surroundings on my mind like a negative. In memorizing Lew Wallace's 'chariot race,' comprising 16 pages, I read it through twelve times. I imprinted the photograph of the page on my mind, and then read what I saw." In poetry the answers bear out the conclusions of Ebbinghaus,

and Müller and Schumann, as to the influence of rhythm. It plays the chief rôle. One is aided by fixing upon the initial letters of each line. Another gets the thought, "and the words which are so closely associated with thought in poetry come of their own accord." Repeating aloud is of service, but form and structure are usually mentioned as the essentials to be considered. Practice improves. One learns easily who memorizes a selection every day and rehearses all at the close of the week. A college student writes: "First of all a feeling of confidence is necessary in all recollection. Doubt breaks the train." The memory must be trusted.

Much the same suggestions are given as to the manner of memorizing fine passages. Slow repetition aids one or two. The reasons given for memorizing these passages are (*a*) beauty of thought, (*b*) beauty of expression. "The author expresses the thought better than I can." "When depressed these beautiful passages come up and encourage me." Other reasons are: "To enrich my mental life," "prevents day-dreaming," "convenient when no book is at hand." "For pleasure and enjoyment" is an answer repeated frequently.

Few devices were given for fixing forms and phrases of foreign languages. Comparison with similar phrases and forms in the mother tongue is found to be serviceable. Even where the native language is as poor as the Indian this device

is found useful. The less familiar are associated with the better known. The beginning of the list of German prepositions, *aus, bei, mit, nach,* etc., is associated by one with the phrase "the house by the meat-market."

A large number of devices are given for keeping appointments. Females change rings, insert paper under a ring, pin paper on dress, etc. There are other favourite mechanical devices. Chairs are turned over, and other furniture disarranged. A middle-aged man hid his hat to remind him of an appointment. Next morning he hunted up another hat, but did not recall why the one usually worn was gone. One associates appointments with the hands of the clock at the hour fixed. Not a few find it necessary to repeat the appointment again and again. Others are aided by a memorandum. As a rule, those who say that their memories are utterly untrustworthy do not use notes. Yet W., m., age 26, writes that the only appointment he has missed for years is one which he noted down. Female, age 16, writes: "To keep an appointment I write the first letter of the person or place connected with the appointment on my left hand. Even if it be erased I still imagine it there." Clear mental representation is the great help in such cases.

There is a wide diversity of opinion as to how full notes a student should take, and almost all degrees of copiousness are indicated. Female,

age 37, believes her memory was injured by taking full notes at the normal school. Again, "too many notes make the general idea of the lecture indistinct." One writes that the state of his health determines how full notes he takes. If the physical tone is low, he is obliged to take more copious notes. Some are best aided by jotting down the headings and by giving attention unreservedly to the lecture. A normal student writes out very full notes, and never thinks of the contents of the lecture until she leaves the lecture-room. Some take "key" words with which the rest is associated. Concentration of attention and "hand and arm" memory are acquired as a rule by taking quite copious notes. To take few notes is a work of art, and the essentials must be seized upon. The consensus of opinions received would seem to favour few notes. Where full notes are taken they are not often reviewed.

The inquiry, "How would you teach a boy to remember things on time?" brought out a large number of specific directions, many of which were of a nature to make the fate of the lone Indian attractive by comparison. The normal students would have him keep a memorandum-book; deprive of some pleasures; give tardy mark; keep after school as long as late; exclude from class and association with other pupils; if late at dinner, give very scanty meal; write down and fix things for him to do in a natural order;

mark o; be on time myself for an example; make him go and get what he had forgotten; tell him true story of boy in trouble on account of forgetfulness; punish if late, and reward for being on time; make him do two or three times as much when he wants to do something else; study the boy; exclude from school; make him write the thing forgotten twenty times; have him repeat what he was to do and when; make him take the natural consequences; whip; lecture; strengthen his memory by having him commit poetry; have him write several hundred times what he had forgotten; give him tasks to perform that could be done only at one time; teach the sin of forgetting; try to interest him; first, ask why, second, keep after school; strengthen his memory by giving him short lessons to learn; show him how it would affect his father's business if his father were not on time; "I once told a forgetful boy to be sure and forget, and if he did I would give him a pretty card. He remembered."

The academic and collegiate students favour corporal punishment. One states that it worked well when he was a boy. The Indians also suggest this remedy. A very sensible suggestion comes from a college woman: "If a boy could not remember things on time, I would try to give him opportunities for practice; I should try to form an association between the thing to be done and the required time or something which would

happen then." The suggestions to study the boy, and make him take the natural consequences; try to interest him; and ask him why, are good from a pedagogical standpoint.

A large number of young people state that they store up facts and dates with no definite idea of how they will use them. This statement applies more to facts than to dates. It is a trait more characteristic of young men than young women. Male, age 20, writes: "I collect facts as I would dollars, expecting to use them in many different ways." While peering into the future, and uncertain as to what resources shall be called out, the young man stores up facts from all sources, with but little thought as to their use.

In reply to question 12, instances are frequently given of a tenacious memory for history or literature, accompanied by little ability for original thought. Such students are usually deficient in mathematical ability. One young girl learns a page easily, but she has to recite it in order, or all is a blank to her. Male, age 19, recalled all that he heard or read, but his conversation and writings were masses of quotations.

On the one hand it is recognized that a rich mental life is impossible without a good memory; on the other, very complete association is often attended by poor constructive power.

The request made under heading 13 of the syllabus called forth a wealth of material. Cer-

tain cases due to abstraction are as follows: A young lady went to telegraph for an umbrella left on a car; she had been holding it over her head for thirty minutes. A lady walked into the parlor with a $10 bill in one hand, a match in the other. She put the bill in the stove and saved the match. A college professor forgets to eat his meals. A boy broke his ribs, and forgot all about it in two days. A man picked up a pebble and put it in his pocket; took out his watch and threw it into the ocean. A lady tried to tie her horse with the blanket and cover him with the line. A boy returned from the store three times to find out what his mother wanted. A lady who was called away by an important message before breakfast, forgot until late in the day that she had eaten neither breakfast nor dinner. A gentleman, age 50, came down from his study and asked his wife if she knew where his pen was; he thought the children had mislaid it. She told him if he would take it out of his mouth he would talk more plainly. A boy, age 9, sent to store for extract of peppermint, brought paregoric; sent back with a bottle labelled peppermint, brought vanilla; third time sent he brought the peppermint. A college professor, expert in numbers, is frequently seen with one black and one tan shoe on. A minister became absorbed in a book and forgot that it was Sunday. A man walked home and left his horse in the village all

night. The same man drove home from church and left his wife.

A great share of cases of lack of memory are due to abstraction, or to absent-mindedness, which Mach terms "present-mindedness." It often characterizes people of great ability along narrow lines of thought. The following is an instance of lack of memory due to fatigue. Female, age 22: "At the age of 16 I had been travelling all day; I went to the ticket-office at the last change of cars, but could not think where I was going, yet I had lived in the town sixteen years."

There are a few instances given in which loss of memory is due to distraction. A middle-aged woman heard of her son's death by drowning. She could not remember her husband's address in order to telegraph him, although she had written there hundreds of times. "Aunt recalls nothing that happens since her husband's death."

Defective memory in children is ascribed to things known. There are many instances reported in which forgetting occurred in the field of things done; many of these cases, however, are evidently cases of temporary forgetfulness due to abstraction. All of the Indians, with a single exception, state that things known are most easily forgotten. As to abstraction, no period of life is free from its influence. Not a few draw comfort from the facts, frequently cited, that Samuel Johnson when he had stepped from

the sidewalk would continue for a long distance with one foot in the gutter and one on the walk; that Pestalozzi did not know enough to put up his umbrella when it rained; that Sir Isaac Newton supposed he had eaten when he saw the chicken-bones on his plate; and that Edison forgot his wedding-day. The fact is that no period of life is free from noticeable abstraction. The boy with book in hand forgets to go to dinner after he has rung the bell; the young woman goes to different parts of the house, she knows not why; middle age hunts for the thimble on its finger, or the pen in its mouth; while old age is troubled that it cannot find the glasses on its nose.

Loss of mind and heredity are much less frequently cited as causes of forgetfulness than abstraction or distraction due to disease.

The fourteenth question was very abstract, and in some instances was evidently misunderstood. The answers came chiefly from young people. Of those who apparently answered in an intelligent manner 140 believed that the interval between being aware of an experience and the ability to define, locate, and name the experience grows narrower as we grow old. Often the period up to middle age only is considered. One qualifies the statement "until old age"; two state that this is true until college is reached; while many consider that it holds until middle age. Not a few of the replies are the outgrowth

of individual experiences, and would not apply after the age of 20 or 22 is reached. 125 state that the interval grows wider. Several state that this is especially true of middle age. The fact is recognized in the returns that the interests of middle life are greater, and the range of one's acquaintances is wider, and that this influences the interval necessary for recognizing and defining an experience. This may not be the only factor, but it seems to offer at least a partial explanation. A fruitful field of inquiry is thus opened up and the ground broken. Prolonged and painstaking study of this problem may be richly repaid.

CHAPTER VII

APPERCEPTION AND ASSOCIATION

And not the slightest leaf but trembling teems
With golden visions and romantic dreams!

SAMUEL ROGERS.

WE saw in Chapter V that each individual has his own memories and that these memories are peculiar to his mental habit.

We will now consider more carefully the nature of the particular relations between the presentations and the mind which receives and retains them. In Fig. 37 different persons see different forms. To the hunter it is a beaver or a woodchuck; to the naturalist a hedgehog or a flounder, according as his mind has been most directed to animals or fish; to a mason it appears to be a trowel, and to a keeper of pets an Angora cat. The astronomer finds in it a cloud which might hinder observation. The street gamin would say it is just an ink-blot, and he would be right. Thus what we see in any presentation is determined by our mental acquisitions and by our habits of life.

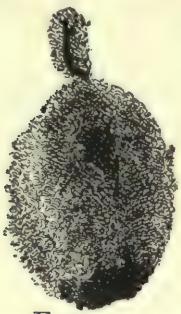

FIG. 37.

It is reported that, at the battle of Sedan, General Philip Sheridan, standing beside Bismarck, noticed that the French emperor was present and that a retreat would soon begin, but Bismarck could not see the confusion about the enemy's headquarters which gave the American general data for a correct inference. This ability had been gained by experience on Southern battlefields. How different, says Lange, Rome seemed to a middle-aged vassal, a Luther, a Herder, or a Goethe. The word father suggests to the child its parent, to the devout Christian, God, to the patriot, Washington. What we perceive to-day is determined by the sum of all life's yesterdays. In daily life this is a well-recognized principle. We infer from the man's conversation whether he be a farmer, an attorney, a physician, a teacher, or a business man. When different men read the same newspaper, they heed what is most nearly related to their professional lives, and the remainder is for the most part unnoticed. The artist notices the light and shadow of the landscape, sees the perspective and the exact location of objects. In the same view, the farmer notices whether the ground is seeded to timothy or clover and estimates how many cows can be pastured there.

> "A primrose by a river's brim
> A yellow primrose was to him,
> And it was nothing more."[1]

[1] Wordsworth in "Peter Bell."

The Malay says of his bamboo forests: "The forest organ plays for each his favourite tune." [2] Steinthal relates that six men were travelling in a railway-coach, one of whom was obliged to get out at the next station. He did not say who he was nor did he know his fellow-travellers, although they had been engaged in a lively conversation. He thought he could discover their occupations if they would answer a question. He took five leaves from his note-book and wrote upon each a question. He then gave a sheet containing a question to each of his fellow-travellers and requested them to write an answer to the question. As he read the answers he said to one, "You are a scientist"; to another, "You are a soldier"; to a third, "You are a philologist"; to a fourth, "You are a politician"; and to the fifth, "You are a farmer." All admitted that he was right. As soon as he left the train, each one desired to know what question the others had received, when it was found that he had given to each the same question, which read: "What creature is it which destroys its own offspring?" The naturalist had answered, "Vital force"; the military man, "War"; the philologist, "Chronos"; the publicist, "Revolution"; and the farmer, "Swine." Each answered what first occurred to him, and the reply in each case was that which stood in closest relation to his life-

[2] Lange.

work. We have, in like manner, a group of ideas which stand in close relation to our professional life, and another group which is religious. Most men have a free-trade or a protection group, and another class of ideas which is closely related to the currency question. As they go through life, each group picks out the presentations related to it and neglects others. The juggler and prestidigitator take advantage of this psychological principle. An admirable discussion of this feature of apperception is given by Professor Jastrow in an article entitled "The Psychology of Deception."[3] We shall quote freely from this article. He accepts Sully's well-known law upon illusions, quoted in Chapter II, and adds that children think that a spoon immersed in water is really bent. Primitive people believe that the moon really grows smaller as it rises above the horizon. Ignorance of the technical knowledge of tricks converts performances into real perception by changing the mental attitude of the spectator. As soon as the latter acquires the purely technical knowledge upon which the success of the artifice depends, he is undeceived. Professor Jastrow illustrates these principles by the following example: A number of rings are collected from the audience upon the performer's wand. He takes the rings to the back of the stage and throws them upon a platter. A pistol

[3] *Popular Science Monthly*, December, 1888.

is needed and handed to the performer from behind the scenes. He hammers the rings and puts them into the pistol. A chest is hanging on the wall by the side of the stage. The pistol is fired at the chest, which is then taken down and placed upon a table in the rear of the stage. The chest is unlocked and found to contain a second chest. This is unlocked and contains a third, and the third, a fourth. From the fourth comes a fifth, which the performer carries to the front of the stage. It is opened and shown to contain bonbons, around each of which is tied one of the rings taken from the audience. The effect is indescribably startling. The *modus operandi* was as follows: In the hand holding the wand are as many brass rings as are to be collected. In walking to the back of the stage, the genuine rings are taken off the wand and the brass rings take their places. This excites no suspicion, as the walking to the back of the stage seems necessary. The pistol is not ready, but must be gone for, and as the assistant hands it to the performer, the latter hands the assistant the true rings. The hammering of the brass rings gives the assistant ample time to tie the rings to the bonbons. While the attention of all is centred upon the firing of the pistol, the assistant unobtrusively pushes a small table on the rear of the stage. The table has a short fringe hanging about it. After showing the audience that the second chest comes from the

first, the first from the second, etc., he can very readily and quickly draw the last chest (the one which contains the true rings) from a groove under the table and bring it out as though it had come from the next larger chest. This is opened and the rings attached to the bonbons are given back to their owners. All think that the last box came from the one taken up immediately before it. The success of the performance consists in inducing the audience to make this simple, natural inference. They also naturally infer that the true rings were hammered into the pistol and fired into the chest. Professor Jastrow adds, the more closely the conditions that lead to correct inferences are imitated the more successful will be the illusions. In like manner he explains the success of spiritualistic phenomena. The subject desires to communicate with a deceased child or other near friend. He half believes that his wish soon will be realized, and this hopeful, ecstatic condition is the first and chief condition of the success of the medium. At last a dim figure is seen and the desired inference is made. In sleight-of-hand performances mirrors play a large part. By means of these a person can appear to be where he was a few moments before, although he really is in a very different place. Another deceptive performance consists in placing a coin under a handkerchief which one of the audience is requested to grasp and to hold above a glass of water. At a given signal he lets

it drop into the glass. The water is then turned out, but the coin has disappeared. The operator has deftly substituted a false bottom to the glass for the coin, and removed the latter when he requested the assistant to take hold of the handkerchief. In a word, the performer appeals to a set of ideas which have been found by experience to be valid, and misleads the audience by apparently, but not really, doing what he desires them to believe has been done. He is aided in this by the fact that people like the occult and are half-willing to be deceived. Indeed, they paid their money to be deceived.

Each individual has, then, different sets or groups of ideas acquired in the past which have been called apperception masses. The masses vary according to education or training,—in fact, according to experience. The state of health and common bodily feelings modify our attitude toward a new perception. As different persons attend to different presentations, so the same person attends to different presentations at different times. We are not only creatures of habit, but creatures of education. Let us note more carefully the process: when a new presentation is made to consciousness, a group of ideas already existing in the mind and which contains elements like this presentation appears at the threshold of consciousness to welcome the new relative. Instead of one group of ideas there may be several containing like elements which

come to honour the new arrival. The new perception may join one or each of these several groups. (1) The apperceived presentation is united to and assimilated with the apperception mass and identified with the latter. It has found a congenial home. (2) This identification is only complete when the new element appears as a part of a new group or groups to receive other percepts and welcome them as it itself was received. The apperceptive process is not always confined to external percepts, as feelings, emotions, and thoughts are apperceived. This has been designated internal or passive apperception, to distinguish it from external or active apperception. "An activity is at work which depends essentially upon the sum and the kind of psychical products already present. . . . The mind apprehends the things of the outer world with the assistance of what it has already experienced, felt, learned, and digested. With nearly all new perceptions the former content of our mind makes itself felt."[4] Hence Lange's definition: "Apperception is therefore that psychical activity by which individual perceptions, ideas, or idea complexes are brought into relations with our previous emotional life, assimilated with it, and thus raised to greater clearness." The more frequently an apperceptive mass is used the more serviceable it becomes and the

[4] Lange.

ideas grow keen. The jeweller detects a flaw or speck which would escape the ordinary eye. The eye of the sailor has no better mechanism than that of the landsman, but by reason of experience he has a good apperception group for detecting and interpreting objects at a distance.

Professor James makes apperception a more complex form of the process of perception, but the same in nature. Many of the child's presentations are not apperceived. Principles and discussions which fail to interest us do not become assimilated. Lazarus speaks of "apperceiving notions which stand like armed men at the threshold of consciousness ready to throw themselves upon everything that appears upon the portals of the senses, overcoming and making it serviceable to themselves." Wundt compares the entrance of a sensation into the field of vision to perception, and its entrance into the focus of vision to apperception.

The term is nearly equivalent to understanding. As soon as the new perception is assimilated, we call it understood. The apperceived idea changes in character. We know that sensations are relative, being invariably modified by the presence of other sensations. In like manner, the newly perceived idea is modified by the group which it joins. On the other hand, the apperceived idea modifies the apperception mass. It may suggest and discover new relations between different portions of the latter, or it may

become the dominant factor and subject to its control the whole previous experience. This is realized in Christian conversion, in which the new idea modifies and subordinates the entire previous mental content and therefore moulds the whole life. A good example is the conversion of Saul of Tarsus. At conversion his whole mental attitude was changed by the idea of consecration to Christ, an idea for which he suffered hardship and an ignominious death. Old things had passed away and all had become new.

The apperceiving ideas become better fixed in memory every time they are called forth to receive a new presentation. The work of assimilating the new idea is a process of association. In the words of Lange, "By connecting isolated things with mental groups already formed, and by assigning to the new its proper place among them, apperception not only increases the clearness and definiteness of our ideas, but knits them more firmly in consciousness. Apperceiving ideas are the best aids to memory." Whatever defects the school of Herbart may have, it has performed a service in placing emphasis upon this important aspect of our mental lives. The richer the mental life in any direction, the easier it is to accumulate knowledge in this direction and the better it is retained. "He that hath, to him shall be given." An artist visits the Metropolitan Museum, the Dresden Gallery, or the Louvre. He knows what to see and where to

look. The delicate shading, perspective, and conformity to nature are noted. He compares the various schools of painting, and nothing apparently escapes his notice. The untrained man visiting the same galleries is bewildered by the magnificence of the rooms, the richness of the gilding, and the multitude of the works of art. After leaving, he may recall a picture of cows, sheep, or that of peasants turning potatoes into a bag, but otherwise his mind is one "blooming, buzzing confusion." How much the reader of history retains depends upon his past acquisitions. If they be meagre, the most salient points of interest will not appeal to him. But if he has made large gleanings and gathered much fruitage in the fields and orchards of the past, his stores will accumulate and his reading will be a labour of love and profit.

To improve what apperceptive groups already exist and to form new ones is our life-work. Life becomes a school in which all things are teachers. They who can proceed from the known to the unknown, from what is better understood to what is less understood, have gone a long way toward attaining a rich mental life and good memories.

The Time Required for Recognition.[5]

The method employed in the following study was extremely simple. Sixty-eight pictures, three to four inches in length and two to three inches in height, were cut from old magazines and pasted upon cards. These were inserted, one at a time, in the clips of the Cattell fall-chronometer and exposed by the sudden falling of the screen. At the instant of exposure, the falling screen released one pendulum of an electrical vernier chronoscope, the other being released by the subject as soon as he was able to decide whether he had seen the picture before or not.[6] If the picture was recognized, the subject reacted with his right hand; if unrecognized, with his left. Five or six reactions to the letters R (right) and L (left) were taken before and after each sitting, and the discrimination times thus found furnish both a control of the other experiments and a means of finding the pure recognition time free from all peripheral processes.

In the tables below, however, these simple discrimination times have not been deducted, but, on the contrary, the full time of response has been retained.

[5] Reprint from the *American Journal of Psychology*, January, 1899.

[6] For the mode of operating the vernier chronoscope, see *Am. Journal of Psychology*, vol. ix., pp. 191-197, January, 1898.

Five subjects were tested, all of whom had had some laboratory experience and two of whom had had a good deal. Five pictures, numbers 1, 2, 6, 44, and 68, were shown each subject before beginning, and he became familiar with them. He also saw them again before each sitting. In what follows they are termed the " well-known pictures." On the first day of experimenting these were shown in irregular order with other pictures from the series. On the second day both the " well-known pictures " and the new ones of the first day could be drawn upon as known pictures to mix with a second group of unknown pictures; and on the third day the pictures of both the first and second days, and so on.

A considerable mass of records was thus obtained, both for the time required for recognizing the " well-known pictures," and for the time required for other pictures after one, two, three, four or more exhibitions. It is hardly necessary to mention that the first recognition, except in cases of mistaken reactions, occurs on the second exhibition and so on. The results for the earlier and later recognitions of the well-known pictures are given in Table I. In forming this table, the series of recognitions for each picture was divided in the middle, if the number of recognitions was even, and the first part taken for the column of earlier recognitions, the second for that of later recognitions. If the number was odd

and the full series could not be evenly divided, the middle term was discarded and the remaining parts treated as if the series had been even.

TABLE I.

SHOWING TIMES FOR SIGNALLING THE RECOGNITIONS OF THE WELL-KNOWN PICTURES; TIMES IN 0.001 SECONDS.*

(The letters M. V. signify the mean variation.)

Subject.	EARLIER RECOGNITIONS.			LATER RECOGNITIONS.		
	No. of Observations.	Time of Recognition.	M. V.	No. of Observations.	Time of Recognition.	M. V.
W	15	524	58	15	451	35
Y	22	490	119	27	432	38
S	17	615	65	19	516	55
K	23	571	124	26	474	68
Q	23	434	110	23	424	71
Average		527			459	

* The times are given in the usual unit for convenience of the reader, though, as the unit of the chronoscope itself was 0.02, no significance is attached to the third figure of the results. It might be expected that with the method of division described in the text the number of observations would be the same for the same subject in both early and later recognitions, and such would be the case except for differences introduced by failures in the functioning of the apparatus, and by erroneous reactions on the part of the subjects.

These figures show that the full time of signalling the recognition of a well-known picture lies somewhere between 424 to 615, and that it is shorter in the second half, where the familiarity was greater. This quickening may be due in part to increased skill in reacting. Two of the five subjects show a similar gain in reacting to the letters R and L, and with one subject, Q, the difference is more than that between the early and late trials in Table I, making the pure recognition times respectively 68 and 89. But it must

be due chiefly to increasing familiarity with the pictures. Four of the five subjects show the same relation in the pure recognition times as in the table. The average pure times, found by subtracting 316 and 311, the simple reaction times, from 527 and 459 respectively, are 211 and 148.

The same thing is shown, though somewhat irregularly, when the successive recognitions of other pictures are examined, as in Table II.

How this increased speed of recognition should be regarded, whether as a hastening of the recognition process or as a gradual change in the character of that process from one which is more or less conscious toward one which is wholly automatic, or as involving both tendencies, is not shown by the data at hand.

Besides this general question there are several of a subordinate interest, namely: Is there any difference in quickness of response when a picture is signalled as unrecognized? Is the quickness of response different when errors are made, i.e., when a known picture is signalled as unknown, or *vice versa?* Is there any difference in the quickness with which different pictures are recognized? Such data as the experiments have furnished upon these points are gathered in the following paragraphs.

In Table III the time for the *first recognitions* has been taken from Table II, instead of the average time of all recognitions, as correspond-

TABLE II.

SHOWING TIMES FOR SIGNALLING SUCCESSIVE RECOGNITIONS OF PICTURES OTHER THAN THE WELL-KNOWN GROUP.

	W			Y			S			K			Q		
	No. of Obs.	Time.	M. V.	No. of Obs.	Time.	M. V.	No. of Obs.	Time.	M. V.	No. of Obs.	Time.	M. V.	No. of Obs.	Time.	M. V.
1st rec....	19	705	111	33	550	100	15	644	129	26	625	124	25	490	95
2 " ...	15	597	82	26	516	99	15	667	101	28	634	139	14	533	98
3 " ...	6	527	47	13	522	75	6	550	73	17	606	114	4	465	83
4 " ...	2	530	50	3	587	142	2	540	60	12	515*	78	1	620	—
5 " ...	1	480	—	2	470	10	1	620	—	5	496	59	1	520	—
6 " ...	1	440	—	—	—	—	1	640	—	1	540	—	—	—	—
7 " ...	1	500	—	—	—	—	—	—	—	1	520	—	1	400	—
Average...	45	540		77	529		40	610		90	562		46	505	

* One record, nearly three times as large as any other, was omitted from this average.

TABLE III.

SHOWING COMPARATIVE QUICKNESS IN SIGNALLING RECOGNIZED AND UNRECOGNIZED PICTURES.

Subject.	RECOGNIZED PICTURES.			UNRECOGNIZED PICTURES.		
	No. of Cases.	Time.	M. V.	No. of Cases.	Time.	M. V.
W	19	705	111	52	618	111
Y	33	550	100	40	583	88
S	15	644	129	48	587*	95
K	26	625	124	49	586	121
Q	25	490	95	43	564	99

* One record, nearly four times as large as that next it in size, was omitted in making this average.

ing more nearly with the condition present when the pictures (before unknown) are signalled as unrecognized. It will be observed that three subjects (W, S, and K) take longer to determine and signal a recognized picture than an unrecognized one; and two, Y and Q, take longer for the unrecognized. This appears to be due to a difference in mental attitude, which will perhaps be clearer after a consideration of the results where errors were made. Y, Q, and K show the same tendencies in Table IV as in Table III; the times of W when in error are practically the same without regard to the nature of the error; while for S the relation of Table III is reversed. The small number of cases and the large M. V. make it seem likely that this difference in the case of S is accidental, and examination of the separate determinations confirms that opinion. The proportion of errors of each sort for the different

TABLE IV.

SHOWING COMPARATIVE QUICKNESS IN ERRONEOUS REACTIONS.

Subject.	WRONGLY SIGNALLED AS KNOWN.			WRONGLY SIGNALLED AS UNKNOWN.		
	No. of Cases.	Time.	M. V.	No. of Cases.	Time.	M. V.
W	9	624	200	20	617	88
Y	19	536	118	27	586	116
S	6	550	137	15	635	98
K	10	614	128	31	570	105
Q	16	461	71	10	516	140

subjects is, however, more characteristic than the times. The percentage of cases in which the error consisted in signalling as known a picture which really had not been seen before is as follows: W 31, Y 41, S 29, K 24, and Q 62. W, S, and K evidently tend less to false recognitions than Y and Q. Furthermore, if the records of the observers in all the tables be compared, it will be found in every case that subject Q made the quickest responses, and that in every case but one (i.e., in wrongly signalling known pictures as unknown, Table IV, second half) Y stands next him in speed, while K, W, and S are always slower, though their order among themselves is different in different tables. Y and Q appear to err by being hasty.

The first inference, perhaps, would be that Q and Y belong to the motor type of reagents and carried their motor habit into these recognition experiments; and there was more or less in Q's manner of reacting to justify such an inference.

Yet, if this were the case, something of the same tendency ought to appear in the records for signalling the presence of the letters R and L. The records, however, fail to show such a tendency; Q is slow as compared with the rest, and Y, though quick in the early part of the series, was excelled by both S and W in the latter part. It seems more probable, therefore, that Q and Y were somewhat on the lookout for known pictures, while the rest expected unknown pictures.

The grading of the pictures according to their difficulty of recognition was made on the basis of the errors recorded against them and checked by a subsequent calculation of the times required for certain special groups; all of the "well-known" pictures were excluded in this consideration.

Ten pictures had no errors at all or but a single failure in recognition recorded against them. They gave, together, thirty-three recognition times, with an average value of 568, and a M. V. of 111. Six pictures, on the other hand, failed of recognition on four or more occasions. These gave, together, nineteen recognition times, with an average value of 583 and a M. V. of 155.

Any statement of reasons for this slowness must be largely conjectural, but the pictures recognized with difficulty seem lacking in interest, either in the situation presented or because they involve a multitude of nearly co-ordinate

details. The pictures that were most often recognized falsely (i.e., signalled as known when shown for the first time) were a group of three drawings of country houses, all executed in a similar and somewhat peculiar manner, and not easily distinguishable in their general aspects, though offering no difficulty when placed side by side. Next these in suffering errors of this kind was a group of eleven pictures, a number of which showed resemblances in subject or treatment to other pictures in the series. As was to have been expected from the nature of the experiment, the general effect is more important in both cases than details.

The general results of this study may be summed up as follows: The central processes of recognition in the case of ordinary magazine pictures take place in a fifth of a second or less, on the average, the time decreasing as the familiarity increases. Whether the judgment that a picture is known takes place more quickly than the judgment that it is unknown seems to depend on the mental attitude of the subject—more quickly if he expects the exhibition of known pictures, less quickly if he expects the reverse. Differences in the facility of recognition are found with different pictures, depending chiefly, it would seem, upon their ability to arouse interest, or, in other words, to compel attention.

ATTENTION AND INTEREST.

ATTENTION is closely related to apperception. Wundt makes apperception the active principle in the attentive mental act. Whatever be our psychology of attention (and each psychologist has his own) we may agree that it is indispensable to the apperceptive process. "The attention which makes the activity of apperception possible is known at once."[1] There are two chief theories of the nature of attention. The first holds that attention is essentially spontaneous and reflex, arising from the affective states. A man or animal incapable of experiencing pleasure or pain would be incapable of attention. Its chief constituents are movements of the face, body, limbs, and the respiratory changes which take place during the attentive state. Ribot champions this view. He says the elements just mentioned[2] are the necessary conditions, the constituent elements, and the indispensable factors of attention. Spontaneous attention is for him the only attention so long as education and artificial means are not set to work. No other kind of attention is found in children and young animals. Attention is composed of the motor elements which come from without.

The so-called voluntary attention comes later

[1] J. Mark Baldwin.

[2] "Psychologie de l'Attention," p. 32.

and is developed out of the spontaneous. Every act of volition, impulsive or inhibitory, acts upon the muscles and by the muscles. The following passage illustrates his view of the origin of voluntary attention: "A child refuses to learn to read. He is incapable of keeping his mind fixed upon the letters which are unattractive to him. But he contemplates with avidity the pictures contained in the book. 'What do these pictures mean?' The father replies: 'When you learn to read, the book will teach you.' After several conversations of this nature, he becomes resigned and sets himself to the task, first slowly, then habitually, and finally shows an ardour which must be controlled. His is a case of the genesis of voluntary attention. It has been necessary to graft upon the natural and direct desire an artificial and indirect desire. The reading is a process which has no immediate attractiveness, but it has borrowed one which suffices." Ribot argues that savages are incapable of voluntary attention. If any savages possess this power, it is the women who work, for attention to duties is an indispensable condition for its development. In the evolution of the race, famine, wars, etc., forced the people to become voluntarily attentive. While voluntary attention must always be psychical inasmuch as it is due to ideas associated with the object to be attended to, yet according to this view (which was shared largely by Fechner) attention is stimulated peripherally,

and in order to study its nature we must study the physical phenomena.

The second view holds that attention is psychical in nature. According to Wundt, attention is largely feeling. There is a field of regard for the attention as for the eye. When a presentation comes into the focus of the attentive consciousness it is apperceived. Apperception is the active principle underneath attention. "Wundt has realized that the having of an idea is not identical with its attentive experience, and that the conditions of attention are not given with the internal and external stimuli which we regard as the physical counterpart of centrally and peripherally excited sensation."[3] The Langes had explained sensory attention by an inner memory image which constitutes the sensation, and had emphasized the difference between sensory and motor reaction, showing the superiority of the former. Having adopted these views, Wundt and his followers ceased to make psycho-physical experiments upon attention. Münsterberg undertook the defence of the psycho-physical basis of attention. He found that motor reactions gave results similar in time and character to sensory reactions—results which the Leipsic school held could be gained only by sensory reaction. He concluded that the will to react is contained in the perception, and that in

[3] Külpe.

motor reaction the subject reacts before he understands the stimulus. Wundt held that choice is independent of the conscious content and is not modified by the latter. In his contributions upon the Oscillations of Attention, Münsterberg concludes: "The entire experiments agree with that interpretation which Lange thought he must exclude, viz., that they (oscillations) are conditioned peripherally and not centrally. Let it be well understood I evidently do not say that the attention is chiefly only a peripheral phenomenon, or that all oscillations of our conscious content find their psycho-physical causes outside of the central organ. I do not even say that the changes of our special case are unrelated to the central reflex paths; I only believe the peculiar effect, the strengthening and disappearing of the sensations, is called forth by processes in the sphere of the conveying sense-organ."[4] Dr. Drew at the close of a painstaking experiment concludes: "Attention is the resultant of tensions," but we do not know what constitutes the motive power back of this tension.[5] The problem is not new. The battle royal was on when Sir William Hamilton wrote. Reid and Stewart held that attention is wholly voluntary. Hamilton admitted voluntary attention, but designated two kinds of in-

[4] "Beiträge zur experimentelle Psychologie," vol. ii., p. 34.

[5] *American Journal of Psychology*, vol. vii., p. 570.

voluntary attention, the one of which is passive and reflex, and the other dependent on desire. The fact that views as far apart as the poles are found both in the old and the new psychology would suggest that each may be right in some measure. That attention is invariably accompanied by motor changes, no one denies. Metaphysical theories as well as the experiments of Wundt and his followers lead us to give little heed to the peripheral phenomena. The grounds may be concisely stated as follows: (1) Attention comes from without, in; (2) It depends upon central stimuli; (3) Or, as Wundt holds, the attentive process is independent of internal or external stimuli and nothing is to be conceded to the physiologist. Is it not true, however, that the stimuli may be both central and peripheral? In accordance with our hypothesis of genetic parallelism and functional interaction in which the neural or conscious element may take the initiative, attention would sometimes be stimulated centrally and at other times peripherally. If the external stimuli prevail, the process is stimulated peripherally. Again, purpose and volition may take the initiative and the process be centrally stimulated. In childhood, the motor elements predominate and determine attention. Professor James quotes a French writer to the effect that the child belongs more to his environment than the environment does to him. G. E.

Müller writes:[6] "If nerve-cells can act on mind, then mind can act on nerve-cells." In voluntary attention the mind adjusts the sense-organs, but objects have the power to suggest the same adjustment that is made immediately by the mind. Psycho-physical experiments show that motor reactions in which the attention is centred upon the motor act are, with most individuals, shorter. It frequently occurs that the subject through expectant attention reacts as soon as the signal is given, and may even anticipate it. On the other hand, sensory reactions in which attention is centred upon the signal are considerably slower.

Attention is nearly or quite synonymous with active consciousness. Krohn and Bolton found that when a given amount of consciousness is directed to one part, it is withdrawn from the other parts of the body. Külpe has enumerated the phenomena which accompany attention. (1) There is an acceleration of the pulse during joyous feelings, and a slowing of the pulse due to unpleasantness. (There can be little doubt that there is a rhythmic relation between the attention and the pulse-beat. While serving as subject, by giving voluntary attention to the heart-beats, I raised the rate of the pulsations six in one minute.) (2) There is a tendency to hold the breath when trying to become attentive. (3) There is an arrest of the movement of

[6] Cited by Dr. Drew.

the body and limbs. "When we fall into a 'brown study' we slacken our pace, or even come to a standstill. If an idea suddenly seizes upon us with full force, we interrupt whatever movement we may be making, quite automatically." There is also a feeling of strain in the scalp and brow and frequently in the ears when attention is active. This has led us to speak of the attention as strained. Such are a few of the more obvious accompaniments of attention. Two forms of adjustment, however, are extremely important: (1) Preperception or mental preparedness; (2) Motor adjustment of the physical organs.

Attention may be immediate or derived. Attention to a subject interesting *per se* is immediate. Attention which derives its interest from some topic associated with that to which we attend is derivative. Again, attention may be involuntary or voluntary; or, as some designate it, passive or active. Professor James holds that voluntary attention is always derived. There is no sustained attention for a long period of time. What seems to be a continued effort is a large number of repeated efforts brought to bear upon the topic. "We can set ourselves new questions about the object so that a new interest in it arises and the attention will remain riveted." [7] It is these interests which induce to

[7] Helmholtz, cited by James.

successive efforts. The active mind continues attentive to a train of thought because new associations continually arise which are of interest. "But it is their genius making them attentive, not their attention making geniuses of them." [8] Attention probably intensifies the content toward which it is directed; yet the apparent intensity may be due to muscular strain. It certainly makes the content clearer and renders fertility of thought possible. Concentration of attention does not produce new associations. It is a favourable though not indispensable condition.

An effort has been made to study the attention in the schoolroom. The process is difficult, for it is impossible for the teacher to tell whether the pupils are attentive or inattentive. It has been assumed that if they took their eyes off the book they were inattentive, but this might be the condition of the most complete attention. The test is inadequate, and the chief value of such results is a renewed psychological interest on the part of the teacher. The question of attention, moreover, becomes one of much hygienic value. The child genius who is ever on the *qui-vive*, and whose attention is under constant strain, is liable to break down entirely or to become prematurely old. Exceptional powers of mind become fatigued or weakened. In ex-

[8] James.

periments upon wakefulness, conducted at the University of Iowa, only 35 per cent. of the sleep had to be made up to restore the subjects to the normal condition. This suggests that the lower nerve-centres may be asleep or resting during the state of inattention. It is certain that inattention is a state of comparative rest, while attention is a state of rapid katabolic changes. Wagner showed that fatigue is greater in the case of attentive pupils. Kraepelin rightly called the inattention of pupils a safety-valve. It is undeniable, however, that work done under pressure is of the best quality. A composition written at intervals is laboured. Examples are cited of prominent authors who remained with pen in hand half an hour waiting for the right sentence. This, however, is no evidence of good composition. As a rule, composition to be of value must be written when the mental activity does not fall below a certain degree of intensity. It is when attention is fixed that the whole subject begins to glow and coruscate and the page receives the die and stamp of the writer's brain processes. It is necessary, however, after a period of work to take a period of rest. The fact already stated that there is no completely sustained attention is our salvation. Dr. Hodge's experiments cited in Chapter IV show how necessary is the rhythm of attention, as well as periods of mind-wandering, reverie, and complete repose. Dr. Ranke, while making observa-

tions upon the Indians in the forests of Brazil, found that the ability of the Indians to see a distant object depended upon knowing where to look and what elements to observe. The power to select certain characteristic sights or sounds seemed indispensable. Dr. Ranke himself was able to improve his vision for distant objects by imitating the savages. This power is in a large measure dependent upon training. Experiments made in the schoolroom show that attention fluctuates with temperature. We have already seen that the inattentive state has its value. An example often cited is, the doctor sleeps while the baby cries; his wife does not hear the office-bell ring. The miller does not hear the whir of the machinery. We do not notice the ticking of a clock, and only are aware that we are conscious of the process when it has stopped. The noise of street-cars, the blowing of whistles, the hum of machinery have no meaning for us during our working hours. Helmholtz's law is that we leave all impressions unnoticed which are valueless to us as signs by which to discriminate things.[9] Diffused attention is the state in which little attention is given to a definite stimulus. Distraction in its mildest form is the opposite of attention and may be little more than inattention. It is inattention to a stimulus because other stimuli are clamour-

[9] Cited by Professor James.

ing for recognition. It, however, may come to designate pathological conditions in which the emotions are violently disturbed. This state is induced by extreme fatigue. There are different degrees in which we may concentrate our attention: (1) There may be a slight amount of concentration when the attention is distributed over

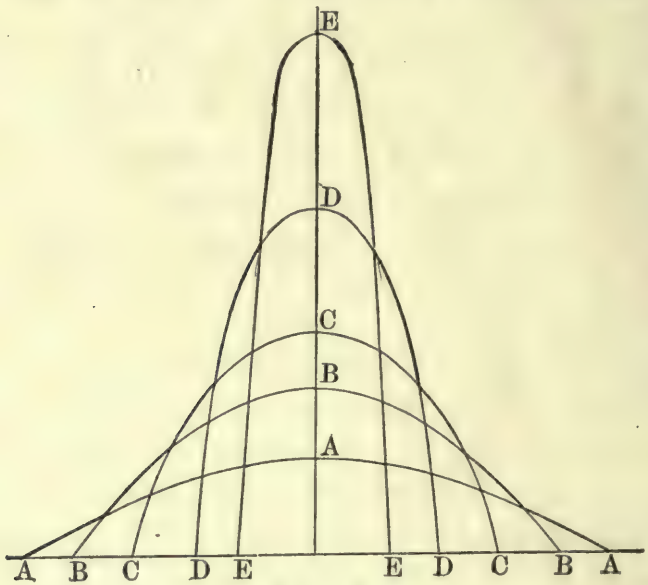

FIG. 38.

a wide area. This is illustrated by the portion of the lowest ellipse *A* shown in the accompanying figure. The other ellipses, *B*, *C*, *D*, and *E*, portions of which are here represented, have the same area. In *B* the conscious content is more concentrated than in *A*. It becomes focused more sharply in *C*, *D*, and *E*. In the upper one the concentration is extreme.

We must get ready peripherally and centrally. We have a given quantity of conscious power. What of consciousness we concentrate upon one topic is withdrawn from others. The thing or its part to which attention is given is apperceived. As Wundt would say, apperception takes place when the object or new relation comes into the line of clearest conscious vision. It is then remembered. What is not attended to is not remembered. Many complain of a poor memory. It is probably not a case of poor memory, but of poor attention. Old people state that they recall well that to which they attend. Persons who do great mental work are those who are capable of sustained or closely repeated efforts of attention. "Archimedes, it is well known, was so absorbed in a geometrical meditation that he was first aware of the storming of Syracuse by his own death-wound, and his exclamation on the entrance of the Roman soldiers was 'Noli turbare circulos meos.'" [10]

"The skeptic Carneades was habitually liable to fits of meditation so profound that, to prevent him from sinking into inanition, the maid found it necessary to feed him like a child." [11] It is reported of Newton that while engaged in his mathematical studies he sometimes forgot to dine.[10] "The mathematician Vieta was sometimes so buried in meditation that for hours he

[10] Cited by Hamilton.

bore more resemblance to a dead man than to a living, and was then wholly unconscious of everything going on around him."[11] Malebranche designated attention as the "force of intellect." Dugald Stewart writes: "It is a matter of common remark that the permanence of the impression which anything leaves upon the memory is proportional to the degree of attention originally given it." Carpenter in his "Mental Physiology" states that Robert Hall and Sir Walter Scott frequently overcame extreme physical suffering by attending to some train of thought. Carpenter himself found that neuralgic pains disappeared while he was giving a lecture. Examples might be multiplied at pleasure, but those cited speak in trumpet-tones. The prerequisite to sustained mental effort and to memory is the ability to concentrate the attention. Ability to remember is power to attend. See the object or topic as a whole. Note the leading characteristics, parts, and relations. Here, as elsewhere in life, "One by one, thy duties wait thee; let thy whole strength go to each." Fix one thing at a time. The root idea of elective courses in the college and the university is that attainments in any line depend upon attention. It is imperative to concentrate. The problem of division of labour in factories and shops is a problem of attention. Such division

[11] Cited by Hamilton.

renders close attention possible. The choice of a limited field makes it possible to know everything about something, while wide experience and a large number of well-defined apperceptive groups enable one to know something about many things. Attention to a portion of the body may cause pain and perhaps disease. Mr. Kay observes that a boxer does not receive injury from blows which are hard enough to kill an ordinary man, partly because he is attentively prepared for them.[12] Who can measure the results of protracted attentive effort? But the apperceptive gun never takes effect unless it is aimed. Attention is the process of aiming. To drop the figure, each man's world is that portion of his environment to which he attends. Attention determines what he is to become. If he attends to mortar, he will carry a hod, and the most important thing for him will be a ladder. But if the brain-cells be numerous and large, and the health good, if he attend to that which interests the statesman and the scholar, if in the midst of a busy life he have time to give thought to the eternities the shadows of which are falling at his feet, if he can attend to the interests of a powerful nation, and at the same time be able to look after the petty details of affairs, if with eye, ear, hand, voice, brain, and mind he attend to the questions which concern civilization most deeply, he may become a Gladstone.

[12] "Memory: What it Is and How to Improve it."

An essential condition of sustained attention is interest. It may consist in relations between ideas, or like the ideas it may be an original elementary factor of the mental life. The Herbartians make interest a consciousness of relations between ideas. For them the indispensable condition of interest is that a presentation be related to an apperceptive mass or group of past experiences.

Professor Baldwin distinguishes [13] intellectual from emotional interest. To the former belong the interests of exploration or discrimination. The child explores its body, later the room, and then other rooms. The intellectually new is interesting, but intellectual repetition diminishes interest. On the physiological side, he states, the laws of habit and accommodation correspond respectively to diminution and intensity of psychological interest. But emotional and volitional reactions make for interest. The office-boy is interested in the letter for himself more than in the letters which he carries for his employers. As a rule, whatever causes pleasure or pain to self is interesting. The questionnaire edited in Chapter VI shows that many people have definite ideas as to whether pleasure or pain is best remembered. Voluntary action, Professor Baldwin continues, leads to interest. "Any effort expended on a thing makes it more worthful to us." While

[13] "Feeling and Will," chap. vii.

custom and habit diminish interest, beyond a certain point they induce it. The old and well-worn book in a subject which will never be renewed is interesting. All that is associated with self is interesting. Interest, then, is the subjective side of the apperceptive function. All stimuli to involuntary attention Professor Baldwin designates as affects. "The passage from affects to interest is the passage from the passive and reactive to the voluntary consciousness." Interest is the "impulse to attend" or "the consciousness of a tendency to think." "The amount of interest an object or topic will have for us at any time is the amount of calling-out force it exerts upon the attention, both by direct suggestion and by association." This condensed résumé does scant justice to his treatment of the subject, but it is sufficient for orientation. The forest leaves, the new-mown hay, the running waters, the songs of birds, all forms of life affect us. If we turn our attention to them, they become interesting, and because they are interesting they keep our attention riveted. "The boys' interests in frogs and polliwogs centre in what they can do, and many of those doings are related to their own personality." [14]

Niagara Falls or a battle-field never interests us so much as at the first visit. So the first time a subject is studied is the golden opportunity to

[14] Professor Earl Barnes.

arouse permanent interests, to gain attention and thus to enable the student to stake out personal claims, good for life, in a new field of knowledge. It is then or never. The ablest teacher and the best text-book (if one be used) should introduce the subject. On the other hand, it is far from true that routine work and repetition are wholly unfavourable to interest, for a study which we take up unwillingly may prove to be the favourite. New interests arise and associations spring up on every hand if the attention be sustained by voluntary repetition. The mind which is trained to do what it ought to do, when it ought to be done, and in the manner in which it ought to be done cannot be called uninterested or uneducated. There is no subject which does not glow with some interest to which voluntary attention is given. The stone by the roadside and the rafters observed in childhood are still a part of the self. Studies by Alfred Binet[15] and Professor Earl Barnes show that children are most interested in the use and activities of objects. This holds true perhaps until the age of 15 or 16. By that time ideals are awakened and the more permanent interests of life are entered upon. Now is the period when " duty whispers low, ' thou must,' " and " the youth replies, ' I can.' " The word " ought " now has a place. That theory of education which bases the elective system on

[15] *Revue Philosophique*, December, 1890, cited by Professor Barnes.

what is attractive and extends it to the Kindergarten does not appeal to the whole life. Lofty purposes, noble action, and the highest ideals are realized in voluntary efforts which go where the richest life is promised, gathering interests as they go. While it is true that to memorize passages of prose and poetry which at the time have little or no interest may enrich the life later when other apperceptive groups are formed and mental associations are multiplied, yet an excess of such work violates the structure of mind and bids defiance to intellectual and pedagogical principles. This process is to a great extent rendered unnecessary when the teacher understands the child and appeals to his past experience. Moreover, in these days of investigation and of getting knowledge at first-hand it is a crime for a teacher to be dull. In many lines of work the student can be taken to the sources. He may make contributions or repeat experiments which have contributed new truths. To the teacher accurate knowledge is important, but it is more essential that he be interested and interesting. We attend in order to become interested and because we are interested. Sustained attention and interest cannot be separated.

In spite of ourselves this section has drifted into pedagogical applications which form the subject-matter of the next chapter.

ASSOCIATION.

Lulled in the countless chambers of the brain,
Our thoughts are linked by many a hidden chain.
Awake but one, and lo, what myriads rise!
Each stamps its image as the other flies.

ROGERS: *Pleasures of Memory.*

ANOTHER aspect of our mental life involved in apperception is the association of ideas. The two are so closely related that they may well form contiguous subjects or different phases of the same theme. Each is a basal fact in mental life, and it is unnecessary to define the association of ideas, for all the world is conscious of the rôle which such association plays in the mental processes. It constitutes the pith and marrow of poetry. Ability to enjoy instrumental music is the ability to associate the fundamental movement with the multiplicity of varied movements, to feel the rhythm and follow the melody through all harmonies sustained or broken, while every emotion and complex of emotion is happily voiced by the instrument. We may inquire, then, what associations are readily recalled, and later discuss the nature of the process and the laws in accordance with which it acts. The English school has found the doctrine of association extremely serviceable from the empirical standpoint. Hobbes, Hume, and Hartley laid the foundation which, as noted in Chapter I, was developed by James Mill, Bain, and Herbert

Spencer. This one phase of mental life has been used by this school to explain the whole. Memory, imagination, judgment, reasoning, and the several emotions are alike explained as association. Memory is the association of a present idea with a past one, while imagination is the association of a present percept with a future one.

While this extreme view concerning association has not been accepted in its entirety, the school has served to emphasize an important mental phenomenon, and it is interesting to note that not only the investigations of Flechsig, but the recent researches of Professor Ziehen seem to afford a neurological basis for this teaching. Professor Ziehen reduces memory, and indeed all mental processes, to idea association, which is referred to the sensations and latent memory pictures. The images are brain traces or latent dispositions in the ganglionic cells. When we see the same object a second time the memory trace becomes a memory picture, psychical in nature, a living idea. The potentially existing memory-cell is awakened by an idea associated with it. From similar objects we pass to the idea of similarity, but in its last analysis association is explained as contiguity. Professor Ziehen's recent inductive work upon the Idea Association of the Child is the best modern contribution, and perhaps the only one, to the subject of association. He finds that in the young child concrete ideas

greatly preponderate, which fact differentiates the child's association from that of the adult. The best mentally endowed scholars were found to have the most of such (concrete) associations. The emotions played a leading rôle in these associations. Association by similarity was very rare, and all of the associations could be explained by the law of contiguity.[1]

Here, as elsewhere, James makes much of habit. Those experiences which habitually have occurred together are easily recalled. A few general principles may be given. (1) Frequency of association facilitates recall. We associate the conductor with the car. The business man associates his city and almost everything else with his store or office. (2) The more recent associations tend to be recalled. To the boy who has just returned from a pleasant ride on his wheel, the word pleasure suggests a bicycle. We recall easily what has latest transpired. (3) Vividness aids the recollection. In Chapter VI we saw that many people remember where they stood when they heard that Lincoln was shot. The cyclorama of Gettysburg, or, better, the field itself, gives lasting impressions and associations. The first journey to the ocean abides as a conserved experience. The last illustration suggests an-

[1] "Die Ideen-Assoziation des Kindes, von Th. Ziehen," Berlin, 1898. This is an inductive study of the association of ideas from tests made upon forty-two boys from 8 to 14 years of age.

other element, (4) primacy. If several objects are presented in a series, the first, in the case of some persons at least, is remembered better than the rest. (5) Association by emotional congruity is of importance. The associations which harmonize with our present emotional state are recalled, and those which do not are forced into the background. Quite different emotions are excited according as we are healthy or sick, happy or sorrowful. When well, we do not think of our physician.

There are different types of association. The first to be noticed is that of complete association. This association characterizes those persons who tend to fill out or redintegrate the entire association content. The whole story must be told or none, for the experience desired cannot be separated from the whole of the mental furnishing. Dame Quickley is the classical example. In the early days of the gold excitement in California, Mr. —— took the stage from an inland village, went to the nearest city, thence to New York, from which port he sailed for California, by way of the Isthmus. After his return, he frequently began to give an account of his journey to his friends and acquaintances, but never succeeded in getting further than the inland city. He was not only slow-spoken, but it seemed necessary for him to tell who were in the stage, what they said, and to describe the dress and deportment of each. At length, one

evening, a number of men decided to hear the whole story. One who was present informs me that when he left at an early hour next morning, Mr. —— had just reached the Isthmus. The experience illustrates this type of association. Such minds are weighed down by details and can never become fertile in ideas.

A more serviceable type is what may be termed selective association. Some elements of the given association are selected, not always consciously, and are accented. They become predominant and form centres of new associated groups. The logical and vigorous thinker is he whose groups of association pertain to the topic under consideration. From these new groups certain elements are again fixed upon, forming new centres. Thus new series of constellations are ever being formed in the mental firmament, but how numerous and how luminous each cluster becomes depends upon the mental vigour of the thinker. Each person determines in large measure which associations shall be regnant and become permanent. "Our memories are like gardens, and the richer they are the more they require weeding." [2]

In order to explain association we may call the association of ideas associations between objects, and reduce the mental part to cerebral processes which consist in an association of

[2] P. Vernon.

neural impulses; or, we may take cognizance of both the physical and the psychical elements and correlate them. What element in the nerve-tissue can make a given element in a mental complex prepotent? When this element has been selected, what force impels the whole flock of neural impulses in a given direction? No doubt that habit and inertia are important factors, but are they enough? A flock of sheep will select the weak part in the fence, and the most of the members will jump because one has gone, but the most hylozoic clods do not select, nor do they move in crowds where one goes. It is the selective power of consciousness which takes the initiative, makes one element more potent than its fellows, and, accompanied by the neural impulses with which it has previously been associated, forms a new centre to build up a new group of associations.

The question of mediate association has been discussed of late, by which term is meant the association of objects not immediately contiguous by means of a third object to which each is related; e.g., Hannibal suggests Napoleon because both crossed the Alps. Mr. H. C. Howe[3] concludes that there is no mediate association. On the other hand, Professor Scripture holds that the theory stands psycho-physical tests. Ebbinghaus found that there is mediate associa-

[3] *American Journal of Psychology*, vol. vi.

tion, and his results in this particular were confirmed by Müller and Schumann.

Immediate associations are recalled quite as well as the objects to which they are related. Professor Jastrow gave ten words separately to students in the University of Wisconsin and in the Milwaukee High School, and after forty-eight hours asked them to write as many of the original words as they could remember. Then he gave the original words, and requested them to write as many words associated with these as they could recall. While one-half of the original words were forgotten, only one-fifth of their associates failed to be recalled.

From the days of Aristotle an effort has been made to determine the laws in accordance with which the association of ideas occurs. Usually they have been reduced to contiguity, similarity, and contrast. Recent authors have explained contrast either as contiguity or similarity, while not a few psychologists reduce the last two to one. Herbert Spencer reduces all three to similarity. Sully recognizes both similarity and contiguity. While James, Ladd, Scripture, Baldwin, and Dewey practically reduce both to the law of contiguity.

Objects and events which have been perceived or experienced together in time or place tend to recall one another. The idea of a liveryman recalls his carriage; the speckled trout the mountain brook; while bright stars recall the clear

skies of our own Western States or western Asia. It is the contiguous objects which are associated rather than the ideas, and they may be conditioned by contiguous brain processes. In most of these associations the physical element may take the initiative, but not necessarily. A neural or a psychical process revives the one with which it was associated in the perception or in the previous recall. The experiences of to-day are recalled in serial order. Indeed, the experience of a year or of life is a series more or less continuous according as attention has been bestowed. The first line of a memorized poem suggests the second, the second the third, etc. But without practice we cannot give a series in the inverted order. It is difficult to repeat the alphabet backward or to recite a selection in inverted order. If, as Julian Hawthorne says, Emerson's essays read as well backward as forward, it would not be easy to recite a memorized passage from Nature in the reverse order, although, as Ebbinghaus showed, there is a backward association which leads to a saving of time in relearning the series. As has been stated, Herbert Spencer and Sully recognize association by similarity. Sully says: "The face or voice of a stranger suggests by resemblance another and familiar one; a word in the foreign languages one in our own," etc. "This kind of association is plainly mapped off from the first. Contiguity associates objects, events, words, etc., which pre-

sent themselves together or at (or about) the same time in experience. Similarity, on the other hand, brings together impressions, objects, or events, mostly remote in time. Thus a face or a bit of landscape to-day may remind us of another scene years ago in a distant part of the globe." Mr. Kay writes,[4] association by contiguity belongs to childhood, and that by similarity to the more mature mind. As the latter develops, the former diminishes. Each has its place, but the memory for relations, including that for all resemblances, we must hold to be the highest power, and is the one which tends to the richer and more serviceable attainment.

A tall, dignified man may remind us of Washington although the two have never been associated together. Here, similarity in stature and bearing constitutes the ground of association. While recognizing association by similarity as a distinct principle, it is easy to see how in its ultimate analysis it is reduced to association by contiguity. It has already been seen that one element in an association may be accented, and becoming prepotent form a new group of associations, itself being the centre. Now, supposing the emphasized element is a quality, as tallness, it forms the centre of a new group. Hence Washington is suggested by the tall man, especially if he have a military bearing. In like manner, the

[4] "Memory: What it Is, and How to Improve it."

Savage rifle may recall the Remington, the Waltham watch the Elgin, the accented element being the make of the gun or the watch.

Herbert Spencer says: "The cawing of rooks is not in itself an agreeable sound; musically considered it is very much to the contrary. Yet the cawing of rooks usually produces pleasurable feelings which many suppose to result from the quality of the sound itself. Only the few who are given to self-analysis are aware that the cawing of rooks is agreeable to them because it has been connected with countless of their gratifications, as with the gathering of wild flowers in childhood; with Saturday-afternoon excursions in boyhood days; with midsummer holidays in the country when books were thrown aside and lessons were replaced by games and adventures in the field; with fresh sunny mornings, in afteryears, when a walking excursion was an immense relief from toil. As it is, the sound, though not consciously related to all of these multitudinous and varied past delights, but only dimly associated with them, raises a dim consciousness of these delights, just as the voice of an old friend, unexpectedly coming into the house, suddenly raises a wave of that feeling which has resulted from the pleasure of past companionship." [5]

The bit of landscape seen to-day reminds us of one seen years ago, because the same colour-

[5] Cited by Ribot in "The Psychology of the Emotions."

ing becomes prepotent and groups around itself landscapes of a similar quality. Thus all association may be regarded as association by contiguity. Wundt's idea of association was given in Chapter I. Auditory images of words, he says, are usually assimilated. Hence sometimes we fill out the process with incorrect assimilation. The cry of animals, therefore, or the sound of water, may seem to be the distant human voice. The more associations an idea has with others the greater is our mastery of the subject. Hence a person who is widely read is better able to retain and utilize facts, while those whose lives run in a treadmill, who have few associations, cannot retain new experiences or what they read well enough to make them of service. Here the laws of association conform very closely to the doctrine of apperception. Spencer and Darwin are encyclopædias of natural history, not only because they have certain well-developed apperceptive groups, but because of many associations for a single fact. It is true, however, that uneducated people, in spite of a paucity of associations, will recall better common experiences of years ago than he who is educated and whose mind has been enriched by travel. They will tell who took —— to a party many years ago, and who danced the first set. This is because of greater and continued attention to the few experiences which have brought change and pleasure into their lives.

To test the permanency of association the author wrote out what he could recall of his primer, school readers, first arithmetics, and geographies. Copies of these books were found, and the impressions were corrected. The notes upon the description from memory of the primer read as follows: "Colour, green; size 6×3 inches; recall the alphabet consisting of large and small letters clearly. I also recall the following words which are represented by pictures: A—Ape; B—Bat; C—Cow, etc. I recall spelling lessons, as: be, by, do, fy, he, lo, me, so, etc.; sentences are recalled, as: 'A big tub,' 'An old rat,' 'A sly fox,' 'A new cap.' I recall a prose selection beginning: 'The sun is up, and I am up, too. Do you see the sun?' Several pictures are recalled, as Henry and his brother fishing for trout; also the poem at the end of the book beginning: 'Kind teacher, when you gave this book.' I cannot recall the name of the author." Such is the primer as remembered. The real primer, when found, was green; size $7 \times 4\frac{1}{2}$ inches; it was entitled "Saunders' Pictorial Primer." The words, sentences, and poem given above were exactly recalled, but the prose selection was not accurately remembered, the order of the sentences being forgotten. I had forgotten how crude the pictures were and had supposed that they would compare favourably with similar representations to-day, but they were very quaint. Before looking into the book, a friend gave me

the beginning of a number of different selections. With this help I could recite portions of most of the selections, but the prose was not so easily recalled as the poetry. Upon opening the book, there was a feeling of familiarity with every page. With one exception, all of the pictures were recognized the moment seen, and I wondered that they had not been borne in mind. The pictures of people and animals especially seemed like recent presentations. The only animal that it took time to recognize was a beaver. It was finally associated with reading one morning in the kitchen. The book had not been seen for thirty-five years. Miss G., age 50, had not looked into this primer for 44 years. She had exceedingly clear images of the pictures. She remembered the pictures of a cow, a horse, and a dog, which I had forgotten. She also recited the selections in verse [6] better than the prose and could recite parts of several prose passages. She recalled the alphabet. She recalled the playground, which I had forgotten. She also recalled pictures and sentences about "Jane and her Bird" which I did not recall until I saw and recognized them. The fact that her mother's name was Jane may have aided this memory. After reading my First Reader for a few days I took up the Second Reader.

[6] The fact that verse was recalled better than prose accords with the results of the experiments of Müller and Schumann.

In the Second Reader, before seeing it, I could recall the selection "Try, try again," and remembered its location on the page. A note made reads: "I recall a selection about a boy rolling a hoop and crying out, 'A fair beat.'" The note upon the Third Reader states: "The colour is pink, but little can be recalled." In the most advanced reader—the School Reader, the name of which had been forgotten—I recalled a selection about "The Cougar," and remembered its location upon the page. The authors of the books could not be recalled. The readers belonged to the series of Salem Town. The First Reader, when seen, awoke no memories or interests. The Second Reader contained the first selection recalled, and it was rightly localized; but the second selection supposed to be remembered could not be found. Other selections, e.g., "Lucy Had a Little Lamb" and "A Place for Everything," as well as the verses beginning "O mother, may I go to school," were immediately recognized and seemed very familiar, but the colour of the book was black! The next day, however, a duplicate of pink colour was found, and this was the colour remembered. Not a single memory of the Third Reader could be recalled before seeing the book. Its colour had been forgotten, and when seen was much larger than I had supposed. As soon, however, as the titles were seen, I could recite portions of more than twenty selections. Some

of these, like "Alexander Selkirk's Soliloquy," "The Captive Children," "Dangers of the Whale Fishery," "The Carrier Pigeon," etc., were remembered topographically. The most advanced book proved to be the School Reader of which I had been able to recall only one selection—"The Cougar." When seen, however, it was almost as familiar as the primer. Fifty-seven prose selections and thirty-one poems were instantly recognized, and I could quote selections from many of them. Webster's spelling-book, which I had seen when a child but never studied, was correctly remembered as to colour and size. Pictures of a cat and birds were remembered correctly. If I found my own spelling-books, they were not recognized with certainty; perhaps because several different books were used. Mitchell's Atlas and Colton and Fitch's modern school geography were quite accurately recalled. Schell's Arithmetic and Perkins' Arithmetic could not be found, but I have a dim memory of the colour, size, shape, and contents of each of these books. The primacy of memory is emphasized by the accurate and quite complete recall of the primer. My experience with the First Reader shows that that to which little attention is given is not remembered and awakens no interest. In the Second Reader the colour and size of the book were remembered much better than the contents. The logical faculty was as yet little developed. The Third Reader and the

School Reader were perused in the period of awakening preceding adolescence. At this time wide interests had been aroused and many memories were suggested. The School Reader suggested other associations in rich profusion: the interior of the old schoolhouse, the knots in the floor, the crack in the stove, the carvings on the benches and desks, the names and faces of teachers and old students, the clothing they wore, the games in which they engaged, the fights, the parties, the schoolboy envy, jealousy, and ambitions—all came back like pleasant dreams of golden days.

CHAPTER VIII

PEDAGOGICAL APPLICATIONS

> But the tender grace of a day that is dead
> Will never come back to me.
>
> TENNYSON.

MANY pedagogical suggestions have been made in the previous chapters, particularly toward the close of Chapter VI and in Chapter VII. It is not our purpose to repeat these, but to discuss a few leading principles. We have seen that all thought is conditioned by brain activity, and it is necessary to bear in mind that a richly endowed, healthy, and well-trained nervous system is an indispensable condition to a good memory. So far as is in our power we should make our nervous system our ally and invite its most complete co-operation. It is evident that loss of memory usually accompanies cerebral disease and frequently results from accidental injury to the brain. It will be recalled that those cortical areas in the brain of Laura Bridgman which had been most used were relatively thicker. The number and size of the brain-cells differ in individuals as their

mental vitality varies. On the neurological side, then, there must exist not only a favourable cerebral endowment, but use and function as conditions of cerebral modification and development, for, as Dr. Carpenter states, the nervous system grows to the mode in which it is exercised. If, on the one hand, Nature sets fixed limits beyond which we may not hope to pass, yet within the limits which she assigns, the memory can be improved. Not until a painstaking course of training has been pursued can we know what these restrictions are. The education of the entire central nervous system and a bountiful and nutritive cerebral blood-supply, which depends upon food and exercise, are essential conditions of good memories. Regular hours for sleep and exercise and sufficient nourishing food are of more service to the child's memories than ambitious school curricula and the reading by course of the Sunday-school library.

In laying foundations for a good memory, childhood and youth constitute the golden period. Then, the neural substance is plastic and medullation progresses most rapidly. Then, if ever, the nervous system can be trained, and its modification is a large part of education. "The power of regrowth is generally much greater during the youth of an animal or during the earlier stages of its development than during maturity. The larvæ or tadpoles of the batrachians are capable of reproducing lost mem-

bers, but not so adults." [1] This principle of regrowth illustrates the susceptibility to change in the nascent nervous system. Then modifications are easy. "The intensity with which any form of exercise is carried on during the growing period leaves its trace, and the absence of it at the proper time is for the most part irremediable.[2] So far as improvement of the memory is concerned, there is much truth in the maxim—"It is always too late to become what you might have been." "Roughly speaking, the plasticity of the nerve-cells is inversely proportional to their age." [3] Many of the leading Roman and English authors had a country training in childhood.[3] Shakespeare's senses were trained [3] harmoniously, and one with untrained senses cannot hope to appreciate his writings.

Questions asked city children as they enter school show that the city child has, as a rule, poorly developed powers of observation. It is as necessary for his education as for his health that he go to the country summers. On the other hand, the country child will profit by a visit to the city, but neither will gain much unless they are taught to notice and to pay attention. Children are interested in all that is alive. When a

[1] Darwin in "Animals and Plants under Domestication," vol. ii., p. 358.

[2] Prof. H. H. Donaldson in "Growth of the Brain," p. 398.

[3] "The Central Nervous System," by R. P. Halleck.

prize was offered to the Worcester school children for the best essay upon "The Toad," teachers testified that interest was infused into various departments of the schools for a term.

We have seen in Chapter V that each sense has its own memory, i.e., we have visual, auditory, gustatory, tactile memories, etc. The visual memory will be improved by a study of frost, snow, flowers, grasses, birds and their nests. For example, the children can note when the bluebird and robin return in spring, and when the swallows, wild geese, ducks, and other birds go and come in their migrations.

The auditory memory is improved by listening to running waters, musical instruments, and that sweetest instrument, the human voice, the barking of the dog, the bleating of the sheep, the lowing of the cattle, the chirping of the robin, the twittering of the swallow, the hum of insects, and the voices of the night, all of which are well calculated to develop power to listen well.[4] We have evidence that taste may be educated in the rare skill of wine and tea tasters. A richness of odour invites the sense of smell. The odour of the rose, violet, the sweet-scented apple-blossoms, the basswood blossoms that bees love so well, and the red and white clover may in turn be studied. On every hand, the temperature, tac-

[4] For a good classification of the stimuli suited to the education of the different senses see Halleck's "Central Nervous System."

tile, and muscular senses may be trained. Sir John Lubbock found [5] that ants are sensitive to ultra-violet rays which our eyes cannot perceive, but there is no need of speculating upon what a beautiful world this would be if we had more senses. Senses, such as we possess, when trained correctly multiply experiences and memories an hundredfold. Manual training educates the senses and thus gives rise to definite motor memories. The child must be placed where different stimuli will act upon his nerve-centres. Suggest to him what is to be seen and done; he will furnish the interest. Specialization can come later. In childhood let there be a well-rounded and symmetrical development of all the senses. Educated senses give clear-cut and definite perceptions and thus furnish definite memories. The senses and their memories are aided by association. This is obvious during our waking hours with the chief senses, such as those of sight and hearing. Many of our memories in dreams may be due to auditory, tactile, and olfactory sensations. Obscure sensations at all times may suggest trains of association, the real cause of which is never realized.

A question arises whether it is best to train the different senses at the same time. It is coming to be a recognized pedagogical principle that if a certain number of years are to be devoted to

[5] "Ants, Bees, and Wasps," pp. 206, 207.

the study of Latin, Greek, French, and German, it is preferable to concentrate upon the Latin for the time which can be devoted to this subject, and then to take up successively the other branches. Is it wise to attempt the training of the child's senses separately? In reply to the question it is evident that, as a rule, this is only possible in theory. One or two instances have been reported in which a single sense—the auditory, for example, in a child that had been deaf in its early years—was educated after the others. The results were not such as to encourage further attempts to educate separately the different senses.

We must recognize in fatigue an obstacle in the way of a good memory. This factor is invariably considered in the psycho-physical laboratory. The experiments of Ebbinghaus, and Müller and Schumann, give evidence that the effect of fatigue upon the memory is marked. As there is a rhythm in the functional activity of the nervous system, there is also one in attention, and from these arises a mnemonic rhythm. All education and mental effort to accumulate knowledge should not be carried to the point of extreme fatigue. In order to overcome the effects of fatigue, sleep and food are necessary. A change of occupation may enable us to use other brain-cells or muscles, but it does not, as many suppose, rest the individual. It may secure a higher degree of working efficiency for

the time, but all toil results in fatigue to the organism.

It has been conjectured that Napoleon could have won the battle of Waterloo with the brain which he had at the age of thirty-five.[6] Surely parents and teachers must realize that the period for laying broad and sure memory foundations will soon pass and the less plastic brain will say, "Thus far canst thou go and no farther."

But is the case closed against adults? What can they do to improve their memories? The large following of each latest mnemonic doctor shows that the case is desperate and that there is a realized need of improvement. The tadpole, if left in the dark and cold for a considerable time, may never make the frog he might have been, yet he need not, under changed conditions, forever remain a tadpole. On the physiological side adults have certain brain-cells undeveloped. No definite limit can be fixed when medullation necessarily ceases. Whether an adult reaches the "dead-line" early or late may depend upon the functional development of nerve-cells or brain areas which have hitherto been unused. Herein lies hope and a possibility of improvement. There may be a little truth at least in the proverb, "It is never too late to become what you might have been." Memories of different modality may supplement

[6] Halleck.

one another. Smell and touch give a better memory image of a rose than either alone. In most adults the sense of hearing is poorly trained and can be improved.

Memory is closely related to habit, and the words have been used as synonyms. Habit takes advantage of the rhythm in the nervous system, of the rhythm of attention and consequently of the rhythm in memory. Habits of attention, of perception, and habits of forming congruous associations are indispensable. Habits constitute the memory and the man. Professor James happily estimates their powers in the following passage: "Already at the age of twenty-five you see the professional mannerism settling down on the young commercial traveller, on the young doctor, on the young minister, on the young counsellor-at-law. You see the little lines of cleavage running through the character, the tricks of thought, the prejudices, the ways of the 'shop,' in a word, from which the man can by-and-by no more escape than his coat-sleeve can suddenly fall into a new set of folds. On the whole, it is best that he should not escape. It is well for the world that in most of us, by the age of thirty, the character has set like plaster and will never soften again." [7]

The trained elephant which has for years gone wild will, if given his old command, lie down

[7] "Psychology," vol. i., p. 121.

and control his ferocity. The trained cavalry horse, after his rider is slain, goes through the old and accustomed manœuvres. Bundles of habits we are, but it is for us to determine what kind of bundles. Late in life, habits are changed with difficulty, but they may be changed. Not a few men and women, silvered with age, grow intellectually when past seventy. While the brain and mental processes are much more plastic in youth, the following sentence of Dr. Carpenter has weight: "There is no part of the organism of man in which the reconstructive activity is so great during the whole period of life as it is in the ganglionic substance of the brain." "In the oldest and most used brains there must always remain vast territories still to be explored and as it were civilized, and in all men multitudes of possible connections continue till the last unrealized." [8]

It is true that owing to the quality of cerebral tissue some people can never hope to possess ready or retentive memories. In their case nurture cannot overcome nature. They must rest content in the assurance that a short memory has its advantages, and that a prodigious memory is not wholly desirable. Cowper congratulated himself on the "great felicity of a memory not very retentive." [9] Montaigne's poor memory, he said, checked his ambition and was a

[8] Henry Drummond, "The Ascent of Man."
[9] P. W. Roose in *Argosy*.

spur to his native wit and judgment. It kept him from storing up memories of injuries.[9] On account of their short memories, to both Montaigne and Cowper, books and places came with an ever-fresh interest.[9] Their great memories injured the popularity of Dr. Johnson, Macaulay, and Carlyle.[9] This statement applies to Roscoe Conkling and James G. Blaine.

Attention plays a powerful rôle in memory. Our memories are almost in direct proportion to the amount of attention bestowed. People past eighty years of age testify that they still remember that to which they attend and in which they take an interest.

> "None grow so old
> Not to remember where they hid their gold." [10]

Much more does this apply to the young and middle-aged. Good memory is due to attentive perception. Concentrated attention is almost a synonym for a good memory. The more diffused the attention the poorer the memory. Miss Catherine Aiken, in her interesting book,[11] states that by arithmetical methods quick perception and rapid and accurate discrimination are gained, which result in improved memories. It may be objected that the training of the memory in one direction does not aid it in other lines

[9] P. W. Roose in *Argosy*. [10] Denham.
[11] "Methods of Mind-training, Concentrated Attention, and Memory."

of work. It is true that the memory trained in one direction is not proportionally serviceable in other directions. A student might by virtue of his studies have a better memory for the details of mercantile life, but his memory along this line of work would not be comparable with that of the merchant who had passed his life in the store. Yet, by the training just described, there is a clear gain in ability to focus the attention, and attentive perception in other directions is secured by means of a more rapid preperception and motor adjustment. The pupils of Miss Aiken seem to justify the quotation which introduces her volume: "Attention is the stuff that memory is made of, and memory is accumulated genius."

A prerequisite condition of a good memory is the increase of associations. A fact seen from many points of view becomes clear and fixed. E.g., we read in Roman history of the Manicheans. We are impressed by the name, and for the time being may know a little of their work. Our idea of them is improved by reading their history in Neander's Church History. If later we take up the life of Pascal and meet with the sect again, our notion becomes clearer and more definite and our memory is surer. Wide reading, extended observation, and whatever tends to multiply associations improve the memory.

Another principle must be emphasized which at first seems to contradict the last one. It is

helpful to form a few definite associations. Two or three associations which are absolutely reliable are extremely serviceable. As it is better to know thoroughly the principal parts of a few irregular verbs in a foreign language than to have a fairly good knowledge of many, so a few clear-cut associations are preferable to a multitude which are less definite.

Repetition is necessary in order to remember. In learning nonsense syllables, Ebbinghaus found that repetition of what was learned effected a considerable saving later in remembering the same syllables. Thurlow Weed, while endeavouring to improve his memory for different experiences, found it serviceable to repeat to his wife at night the conversation and the names of the men whom he had met during the day. Thus he improved his memory for facts, names, and faces. According to Cicero, Cato, for a like reason, rehearsed at night what he had said, heard, and done during the day.

It is advantageous to most people to take notes upon what they wish to remember. The effort of writing secures greater attention and invites the aid of co-operative memories by the use of the arm, the hand, and the fingers. For these reasons, it is probably true that a person who takes notes and never looks at them again remembers the facts or experiences more accurately and tenaciously than he who does not write. Sir Walter Scott dictated the novel

"Ivanhoe" from a sick-bed. At the conclusion of the work he remembered those parts only which he had written out with his own hand.[12] From the standpoint of memory, the disadvantage of this method of work has been emphasized, but the habit of taking notes upon every book that one reads makes for intellectual efficiency. Life is so short that we cannot afford to read many books twice. Judicious and accessible notes upon all books read and upon those sayings heard which are worth preserving render it unnecessary to burden the memory with a thousand details, and will in time account for a large part of the difference between a commonplace intellect and that of the genius.

There is, on the other hand, an advantage which comes from trusting the memory. Not a few persons state that they are helped by putting confidence in their memory. They believe that trusting the mnemonic ability makes it a true servant. It is not easy to analyze the process and to determine in what the advantage consists. The mental attitude described by trusting the memory removes apprehension as to results, and for this reason better associations may be formed. Such a mental condition is favourable to recall. It is also favourable to a large degree of attention. The habitual liar has a poor memory, partly, at least, because it becomes impossible for him to trust it. Public speakers who

[12] H. Hartshorne in *The American*, vol. v., p. 9.

use few or no notes are apt to find that their memory improves.

Feelings associated with objects and acts play an important rôle in memory. Feelings of symmetry, harmony, proportion, logical feelings, as well as the emotions of love, hate, joy, grief, anger, and resentment, all tend to be recalled, and with them the mental images with which they are associated.

Fauth emphasizes the æsthetic feelings for the beauty of the whole, as they make us dissatisfied with a partial or fragmentary reproduction. He adds: "Feelings associated with certain sensations and ideas again appear with analogous sensations and ideas to reinforce them."

> "Tears, idle tears, I know not what they mean,
> Tears from the depth of some divine despair
> Rise in the heart, and gather in the eyes,
> In looking on the happy autumn fields,
> And thinking of the days that are no more." [18]

The study of language has already been emphasized. The habit of careful discrimination, —of noting nice adjustments and relations, is invaluable to memory. Gems of literature rich in associations should be memorized early in life. They determine the memory tone and enrich the whole mental content. Language is the symbol of the nation's best thought, the treasure-chamber of its richest experiences. The study of the mother tongue is of the highest importance.

[18] Tennyson, "The Princess."

As has been stated, the ancients had their mnemonic systems, and all modern peoples have what Dr. Pick has well called memory doctors. The author just cited has one of the very best of mnemonic systems, in which he forms series of pairs of related ideas. In recalling dates and historical events a certain amount of help is afforded by using consonants for figures and by supplying the vowels. Thus a word comes to represent a date and the historic event associated with it. This device translates meaning into figures. Will it pay to join the mnemonic class just being organized by Professor ——, who "has greatly improved upon all other systems"? Generally speaking, yes. It will afford a training of attention. There will be a contagion of enthusiasm from the fact that a large number of people will cooperate in the task and more effort will be exerted. The system itself may not by any means be worthless. But all such systems burden the mind with additional facts which become means of recalling the original ones. A given amount of psychical energy is divided between the two processes instead of becoming centred upon one.

Most people cannot easily remember faces. The difficulty is inaccurate perception. "A large proportion of mankind, as every great painter will testify, never see faces accurately at

all."[14] The writer just quoted adds, they see types of faces only. They never note individual characteristics. A few years ago a Chinaman was acquitted of murder in New York State, chiefly upon the ground that all Chinamen look alike. Yet the details of each celestial's face are different. The apostle James knew, perhaps by experience, how easily one upon leaving a mirror forgets how he looks.[14] People who would not recognize their own double would surely need to take pains to recognize others. Yet not a few college presidents and principals of schools very readily recognize faces. Of course there is no special memory for faces. It is simply a matter of cultivating the habit of careful perception. It is poor seeing, not poor memory. It is not enough to know the type of face. The slight individual variations and peculiarities and the special characteristics must be noted. The colour of the hair and eyes, and the complexion as well as the contour of the features, differ in each. One must reflect upon these particular features after leaving the newly formed acquaintance and associate these traits with the name. Painstaking attention to details and repetition will lead to success.

The daily newspaper is indispensable, but the habit of reading it in detail is not conducive to a good memory. It presents in a brief period many topics to the mind, and few or none are

[14] *Spectator*, vol. 58.

assimilated. One had better select the chief topics and so far as it is possible read the essentials only.

Interest is closely related to attention, and it is essential to good memories.

> "I cannot but remember such things were
> That were most precious to me." [15]

He remembers well whose interests are wide. On the other hand, the so-called selfish man who short-circuits his interests, who is little interested in his nation or its policies, who cares little for the experiences of other nations and naught for his own ancestors narrows down his memories. "What's Hecuba to him, or he to Hecuba?" A wide range of interests and genuine altruism are mnemonic helps.

Finally, order is essential to memory. If we learn facts in a methodical manner, we easily recall them. The painstaking housekeeper can always put her hand upon what is wanted. The scientist has his orderly classification. The methodical work of the banker is almost in itself a mnemonic system.

The improvement of mnemonic work in our schools will take place if the need of such work be realized. The ability to memorize the essentials of a subject so as permanently to enrich the life may, in years to come, be compared to a lost art or to a rudimentary organ. Opin-

[15] Shakespeare.

ions upon this point differ so widely that it is difficult to find a common starting-point. It may, however, be stated that a teacher is not efficient in proportion as the pupils know little of the subjects studied. One who realizes the danger suggests[16] that each school have a memory master who is to know at least the rudiments of physiological and psychological science. He might train the pupils by classes in which he would question one in Euclid studied two years before, and another in Latin studied six months earlier. Perhaps the whole matter may be left to the common sense of teachers who are alive to many pedagogical maxims and who have a genuine interest in the pupils. We are obliged to leave the subject with them, for no definite boundary can be drawn between the task, on the one hand, of acquiring what is new and interesting and, on the other hand, of laying up permanent stores of information. The two processes need not exclude each other. Each has its place, and each teacher must decide which is to receive the stronger accent. We ask only that the cultivation of the memory have a place in every educational system.

A question arises as to the mnemonic value of examinations. They must deal mainly with superficial knowledge, and cannot easily test the central knowledge that has become rooted in

[16] W. Vaughn in *Education*, xii., 468.

the core and fibre of mentality. On the other hand, they encourage cramming, and even put a premium upon knowledge gained in a short time which must soon perish. It is needless to state that the greatest portion of such knowledge does not become a permanent possession of the psychic life, and that it leaves no well-defined modification of the central nervous system. Such knowledge may not be wholly lost, but it cannot constitute a definite and permanent possession. So far as good memories are concerned, sustained interest in the classroom and ability to hold the attention are far more serviceable than examinations. In one point only are examinations of service. In most professions one's relative success depends upon securing a vast amount of information in a short time. Thus the lawyer works up his case in a thousand details during a brief period. The minister is obliged to do likewise in the preparation of sermons and addresses. This mode of acquisition is valuable to the public speaker and to the orator. For this purpose examinations are a preparation, and the process of cramming may stand the professional man in good stead in later years. This training, however, is relatively insignificant when compared with the detrimental effects first mentioned, and the reasons for holding examinations are based chiefly upon other grounds than the one here given.

No one of the principles here stated is ade-

quate in itself, but if observed as a whole it is believed that they will be found serviceable. Given brain-cells, numerous and large, a body adequate to their support, sufficient nutritive food, a good blood-supply, a mind educated to see, hear, smell, taste, and feel, a careful motor training; with these advantages let him who would remember become studiously attentive; ever on the lookout for what is new, let him take it from his environment and weld it to the old; let him keep hopeful and growing, with ever-widening sympathies and interests, while his life grows richer and unfolds in accordance with a purposeful plan, and his memories will take care of themselves, for they comprise the life, and in their summation are little else than character.

> "Departed suns their trails of splendor drew
> Across departed summers. Whispers came
> From voices, long ago resolved again
> Into the primeval Silence, and we twain,
> Ghosts of our present self, yet still the same,
> As in a spectral mirror wandered there." [17]

[17] Bayard Taylor, "Poet's Journal."

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